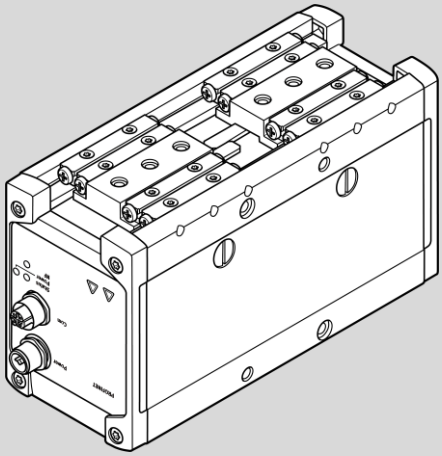
HEPP
Parallel gripper



FESTO

Operating instructions

8229007
2024-12a
[8229009]

Original instructions

Table of contents

1 Applicable documents

About this manual

This documentation is intended for safe working with the HEPP gripper.

Target group

This documentation is intended exclusively for technicians trained in control and automation technology who have experience in installation, commissioning, programming and diagnostics of electrical drive systems.

All available documents for the product ➔ www.festo.com/sp

2 Product labelling

Warning symbols on the product	
	If the housing is damaged, protection against dangerous voltages is no longer guaranteed. Claw fingers may accidentally move and squeeze body parts Depending on the operating conditions, the component surface will have a higher temperature. In addition, the surface will also become high temperature when it is only powered on and not running. In order to avoid scalding, it is absolutely forbidden to touch the electrified motor with your hands

Tab. 1 Warning symbols on the product

3 Safety

3.1 Safety instructions

- Observe labelling on the product.
- Before working on the product: switch off the power supply, ensure that it is off and secure it against being switched on again.
- The occurrence of a failure could lead to unforeseeable movements if the product is connected with the power supply. Only operate the product once protective measures have been taken against mechanical hazards to body parts.
- Observe tightening torques. Unless otherwise specified, the tolerance is ± 20 %.
- Please use it within the specification range of the payload, If the HEPP gripper does not hold the payload firmly or correctly, the payload may be thrown out fast and unexpectedly during the gripper movement, thus cause personnel injury or equipment's damage.

3.2 Intended use

The intended use of the product is to grip and hold payloads (workpieces) using custom-designed gripper fingers attached by the customer.

3.3 Foreseeable misuse

When not used as intended, the product-supported protection can be impaired.

3.4 Training of qualified personnel

Work on the product may only be carried out by qualified personnel who can evaluate the work and detect dangers. The qualified personnel should have skills and experience in dealing with electrical control technology.

4 Additional information

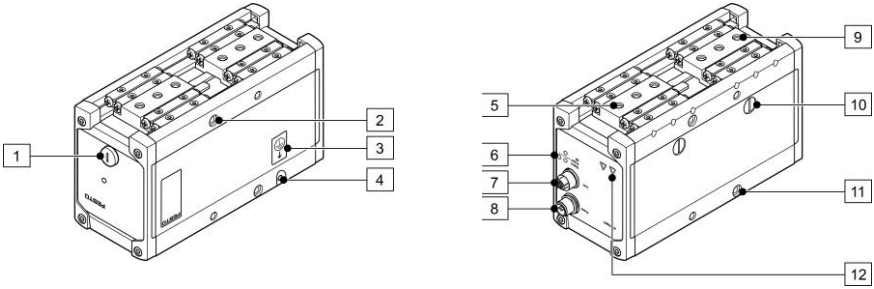
– Contact the regional Festo contact if you have technical problems ➔ www.festo.com
– Accessories and spare parts ➔ www.festo.com/catalogue

5 Product overview

5.1 Function

The HEPP gripper has an integrated servo motor. The gripper mechanism converts the rotary motion of the servo motor into a linear motion of the gripper jaws.
The gripper jaws move towards one another (closing) or apart (opening). Gripper fingers are fastened to the gripper jaws.
The payload can be gripped in 2 ways:
– on the external contour (external gripping) when closing
– on the internal contour (internal gripping) when opening
The parallel gripper is controlled via the EtherNet/IP, EtherCAT, PROFINET interfaces.

5.2 Structure



1 Plug screw for manual operation
2 Locating hole and threaded hole for mounting
3 Indicating tag for grounding
4 Threaded hole for ground connection
5 Locating hole and threaded hole for gripper finger mounting
6 Indication LEDs
7 Communication M12 connector
8 Power M12 connector
9 Gripper jaw
10 Plug screw re-lubricating hole for ball screw
11 Locating hole and threaded hole for mounting
12 Warning symbol

Fig. 1 Parts overview

The threaded hole for ground connection may not be used in regular operation necessarily, it is mainly used for special cases such as EMC test.

6 Storage

– Store the product in a cool, dry environment protected from UV and corrosion. Keep storage time short.

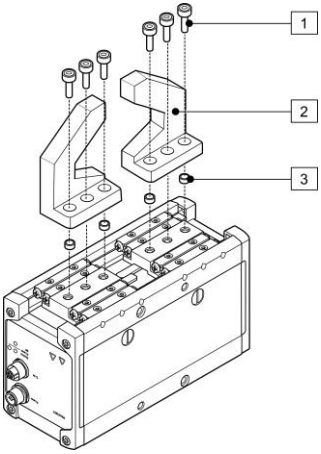
7 Assembly

7.1 Preparing the gripper finger

The gripper fingers are not in the scope of delivery

Requirements for the gripper fingers ➔ Technical data:
– Observe the max. permissible forces and max. permissible torques at the gripper jaw.
– Observe the max. length and max. weight.
– Use fingers that are as short and light as possible.
– Manufacture gripper fingers that are suitable for the payload and type of gripping action.

7.2 Mounting the gripper fingers



1 Screw
2 External gripper fingers
3 Centering sleeve or centering pin

Fig. 2 Gripper finger mounting

1. Press centering sleeve or centering pin [3] into the locating holes in the gripper jaws.
2. Position the prepared external gripper fingers [2] on the gripper jaws and secure with 3 screws [1] on each. Fix gripper jaws in place during mounting and use the specified tightening torque.

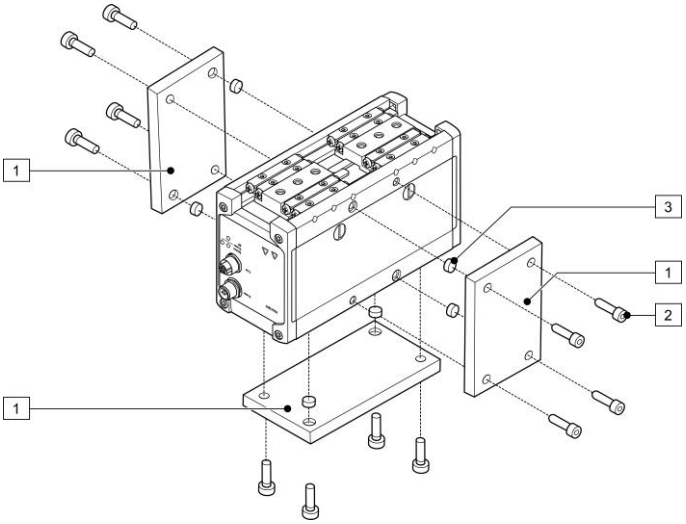
HEPP	-28	-36	-42
Screw (e.g. according to ISO 4762)	M3	M5	M5

HEPP	-28	-36	-42
Max. screw-in depth [mm]	5.5	8	8
Centering hole [mm]	Ø5H8	Ø7H8	Ø7H8
Tightening torque for thread [Nm]	1.2	5.9	5.9

Tab. 2 Mounting attachments and tightening torque

7.3 Mounting the gripper

7.3.1 Direct mounting



1 Plate with counter holes for screws and centering sleeves
2 Screws
3 Centering ring (not in delivery scope)

Fig. 3 Direct fastening

HEPP	-28	-36	-42
Screw (e.g. according to ISO 4762)	M5	M6	M6
Max. screw-in depth [mm]	8	10	10
Centering hole [mm]	Ø7H8	Ø9H8	Ø9H8
Tightening torque for thread [Nm]	5.9	9.9	9.9

Tab. 3 Mounting attachments and tightening torque

7.3.2 Mounting with adapter kit

Adapter kits ➔ www.festo.com/catalogue

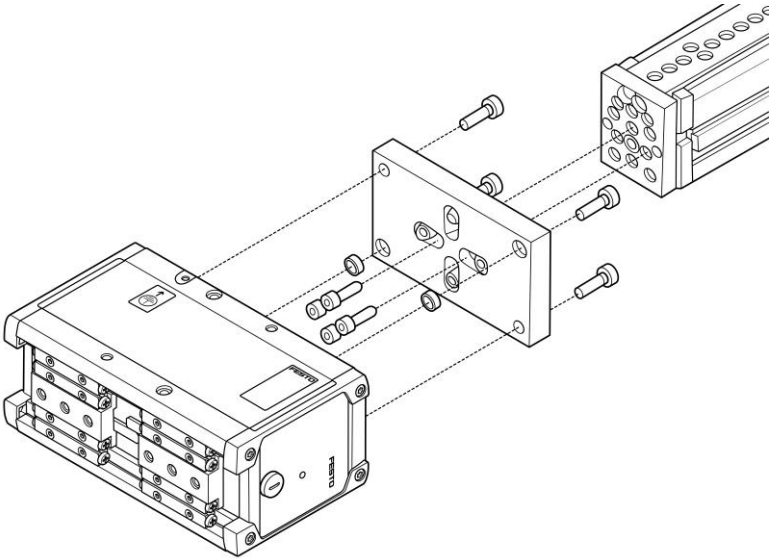


Fig. 4 Mounting with adapter kit from below

Accumulation of heat results from cramped installation situation, material damage or malfunction, mount the product with sufficient space for heat dissipation.

1. Press 2 centering sleeves into the locating holes of the HEPP gripper.
2. Use the centering sleeves to position the HEPP gripper on the connecting surface.
3. Select screws in accordance with the type of mounting.
4. Tighten screws with the associated tightening torque.

8 Installation

8.1 Electrical Installation

⚠ WARNING

Risk of injury due to electric shock

For the electric power supply, use only PELV or SELV circuits that ensure a reliable electric disconnection from the main network.

⚠ WARNING

Risk of injury due to electric shock or burns.

The gripper does not offer any additional protection against unintended high currents in the supply cables.

The cross section of the supply cables should be designed to meet the maximum current value that could occur in the event of a failure.

⚠ WARNING

Danger of crushing.

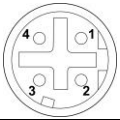
The gripper fingers could move unintentionally and crush body parts.

Do not reach into the movement range.

1. Switch off power to the controller and safeguard it from being switched on again unintentionally.
2. Use permissible connecting cable ➔ www.festo.com/catalogue.
3. Connect the HEPP parallel gripper to the controller at the connection plug.

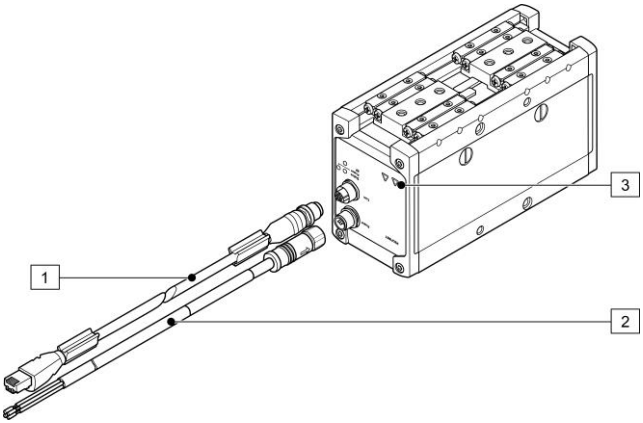
⚠ WARNING

Danger of crushing due to unexpectedly moving loads and unintentional movements.

Type	Pin	Connection	Function
Com, D code 	1	RXD+	Receive data
	2	TXD+	Transmit data+
	3	RXD-	Receive data-
	4	TXD-	Transmit data-
Power, T code 	1	+24V DC	Motor power
	2	GND	Ground
	3	+24V Logic	Logic power
	4	FE/PE	Function ground

1) Wire color with use of connecting cables according to accessories ➔ www.festo.com/catalogue

Tab. 4 Pin allocation



1 HEPP parallel gripper communication cable
2 HEPP parallel gripper power cable
3 Warning symbol

Fig. 5 Electrical installation

1. Connect the PLC to the accompanying communication cable [1].
2. Connect the HEPP parallel gripper with the power supply cable [2].

Installing power supply robotic cables

Festo provides 2 kinds of power supply robotic cable with both angular and straight M12 connector types.

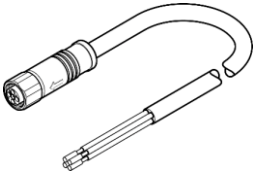


Fig. 6 NEBM-T12W4-R-...-LE4

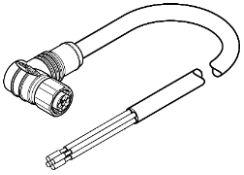
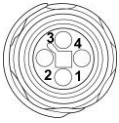


Fig. 7 NEBM-T12G4-R-...-LE4

Type	Pin	Connection	Function
T code 	1 BN	+24V DC	Motor power
	2 WH	GND	Ground
	3 BU	+24V Logic	Logic power
	4 BK	FE/PE	Function ground

Tab. 5 Pin allocation

9 Commissioning

9.1 Product configuration

9.1.1 Controller

9.1.1.1 Parameter set

Default and factory settings, user parameter set

Various parameter sets are available for work on the HEPP gripper.

Parameter set	Description
Factory parameter set	Device-specific parameter set, contains the specific default values of the HEPP gripper.
User parameter set	Application-specific parameter set in device; parameter values are defined by users.

Tab. 6 Parameter sets

Changed parameters must be saved on the device; otherwise the last parameter set will become active again after a restart

Sequence at the start-up of the HEPP gripper and establishment of an online connection

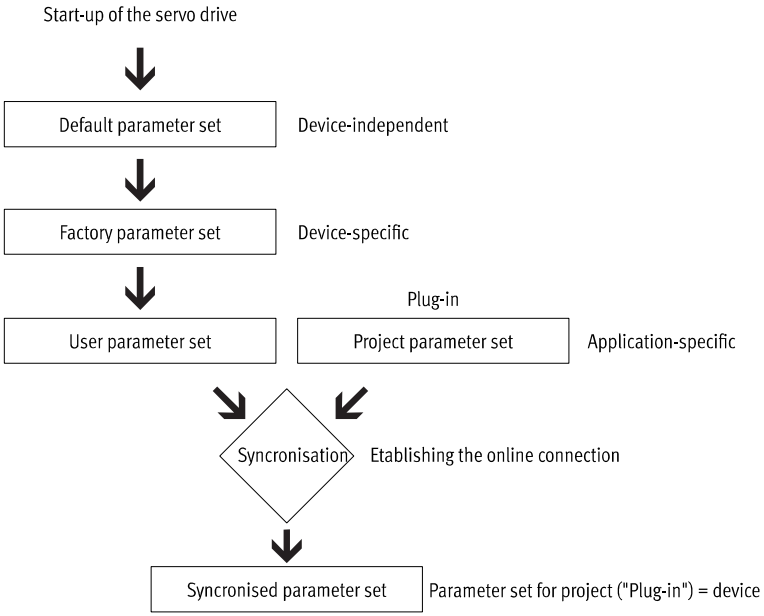


Fig. 8 Sequence at start-up

9.1.1.2 Device services and methods

Device services are executed by the methods described in the following sections. Functions close to the hardware, such as reset of the device, can be called.
Before calling a method again, the method call must be reset (control = 0). After that the execution of the method is possible again, as shown in the following diagram.

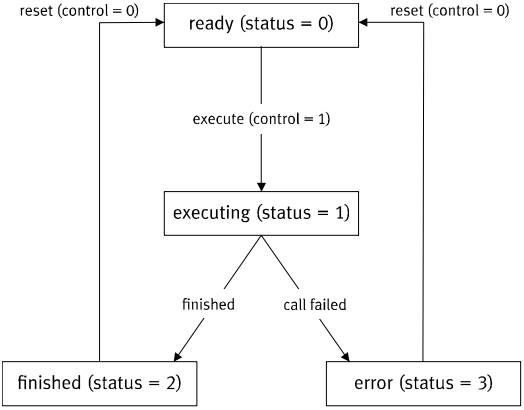


Fig. 9 Method call

The status query of a method delivers one of the following return values:
Method status:
– 0 = ready
– 1 = execute
– 2 = ended
– 3 = error
The query of the return code of a method delivers one of the following return values:
– 0 = successful
– 1 = error

9.1.1.2.1 Reset device

CiA402

Method	Object	Data type	Function	Description
Reset Device	0x2000.01	USINT	Control	Value = 1: execute method Value = 0: reset method

Tab. 7 Device reset method

PROFIdrive

Method	PNU	Data type	Function	Description
Reset Device	1000	Unsigned8	Control	Value = 1: execute method Value = 0: reset method

Tab. 8 Reset device

9.1.1.2.2 Controller parameter set switchover

CiA402

Method	Object	Data type	Function	Description
Controller parameter set switchover	0x2001.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2001.02	USINT	Status	Status
	0x2001.03	UDINT	Transfer value	0 ... 2: controller parameter set ID
	0x2001.04	REAL	Transfer value	0 ... 100: transition time [s]
	0x2001.05	UINT	Return value	Return code

Tab. 9 Controller parameter set switchover

PROFIdrive

Method	PNU	Data type	Function	Description
Controller parameter set switchover	1002	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1003	Unsigned8	Status	Status
	1004	Unsigned32	Transfer value	0 ... 2: controller parameter set ID
	1005	Floating- Point	Transfer value	0 ... 100: transition time [s]
	1006	Unsigned1 6	Return value	Return code

Tab. 10 Controller parameter set switchover

9.1.1.2.3 Save zero point offset

CiA402

Method	Object	Data type	Function	Description
Save zero point offset	0x2002.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2002.02	USINT	Status	Status
	0x2002.03	UINT	Return value	Return code

Tab. 11 Save zero point offset

PROFIdrive

Method	PNU	Data type	Function	Description
Save zero point offset	1007	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1008	Unsigned8	Status	Status
	1009	Unsigned1- 6	Return value	Return code

Tab. 12 Save zero point offset

9.1.1.2.4 Request ReInit

CiA402

Method	Object	Data type	Function	Description
Request ReInit	0x2003.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2003.02	USINT	Status	Status
	0x2003.03	UINT	Return value	Return code

Tab. 13 Request ReInit

PROFIdrive

Method	PNU	Data type	Function	Description
Request ReInit	1010	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1011	Unsigned8	Status	Status
	1012	Unsigned16	Return value	Return code

Tab. 14 Request ReInit

9.1.1.2.5 Delete parameter set

CiA402

Method	Object	Data type	Function	Description
Delete parameter set	0x2004.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2004.02	USINT	Status	Status
	0x2004.03	UINT	Transfer value	Value = 1
	0x2004.04	UINT	Return value	Return code
	0x2004.05	UINT	Return value	Value = 1

Tab. 15 Delete parameter set

PROFIdrive

Method	PNU	Data type	Function	Description
Delete parameter set	1013	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1014	Unsigned8	Status	Status
	1015	Unsigned16	Transfer value	Value = 1
	1016	Unsigned1 6	Return value	Return code
	1017	Unsigned1 6	Return value	Value = 1

Tab. 16 Delete parameter set

9.1.1.2.6 Save parameter set

CiA402

Method	Object	Data type	Function	Description
Save parameter set	0x2005.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2005.02	USINT	Status	Status
	0x2005.03	UINT	Transfer value	Value = 1
	0x2005.04	UINT	Return value	Return code
	0x2005.05	UINT	Return value	Value = 1

Tab. 17 Save parameter set

PROFIdrive

Method	PNU	Data type	Function	Description
Save parameter set	1018	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1019	Unsigned8	Status	Status
	1020	Unsigned16	Transfer value	Value = 1
	1021	Unsigned16	Return value	Return code
	1022	Unsigned16	Return value	Value = 1

Tab. 18 Save parameter set

9.1.1.2.7 Cam controller 0

CiA402

Method	Object	Data type	Function	Description
Cam controller 0	0x2006.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2006.02	USINT	Status	Status
	0x2006.03	UINT	Transfer value	Mode (Px.112700)
	0x2006.04	UINT	Transfer value	Update mode – 0 = apply immediately – 1 = apply with the next modulo overflow
	0x2006.05	UINT	Return value	Return code

Tab. 19 Cam controller 0

PROFIdrive

Method	PNU	Data type	Function	Description
Cam controller 0	1036	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1037	Unsigned8	Status	Status

Method	PNU	Data type	Function	Description
	1038	Unsigned16	Transfer value	Mode (Px.112700)
	1039	Unsigned1 6	Transfer value	Update mode – 0 = apply immediately – 1 = apply with the next modulo overflow
	1040	Unsigned1 6	Return value	Return code

Tab. 20 Cam controller 0

9.1.1.2.8 Position capture (touch probe) 0

CiA402

Object 0x60B8

Object 0x60B8 enables configuration of the touch probe function.

Bit	Value	Description
0	0	Switch 0 off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	continous
3, 2	00	Trigger with touch probe 1 input (fix)
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6, 7	–	reserved
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	continous
11, 10	00	Trigger with touch probe 2 input (fix)
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14, 15	–	reserved

Tab. 21 Value definition of the object 0x60B8

Object 0x60B9

Object 0x60B9 returns the status of the touch probe function.

Bit	Value	Description
0	0	Touch probe 1 is switched off

Bit	Value	Description
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 positive edge position stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 negative edge position stored
3 to 7	0	reserved
8	0	Touch probe 2 is Switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 positive edge position stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 negative edge position stored
11 to 15	0	reserved

Tab. 22 Value definition of the object 0x60B9

PROFIdrive

Method	PNU	Data type	Function	Description
Position Capture (Touch-Probe) 0	1046	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1047	Unsigned8	Status	Status
	1048	Unsigned16	Transfer value	Mode (Px.113000)
	1049	Unsigned1 6	Return value	Return code

Tab. 23 Position capture (touch probe) 0

9.1.1.2.9 Position capture (touch probe) 1

CiA402

Object 0x60B8

Object 0x60B8 enables configuration of the touch probe function.

Bit	Value	Description
0	0	Switch 0 off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	continous
3, 2	00	Trigger with touch probe 1 input (fix)
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1

Bit	Value	Description
6, 7	–	reserved
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	continous
11, 10	00	Trigger with touch probe 2 input (fix)
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14, 15	–	reserved

Tab. 24 Value definition of the object 0x60B8

Object 0x60B9

Object 0x60B9 returns the status of the touch probe function.

Bit	Value	Description
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 positive edge position stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 negative edge position stored
3 to 7	0	reserved
8	0	Touch probe 2 is Switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 positive edge position stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 negative edge position stored
11 to 15	0	reserved

Tab. 25 Value definition of the object 0x60B9

PROFIdrive

Method	PNU	Data type	Function	Description
Position Capture (Touch-Probe) 1	1050	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	1051	Unsigned8	Status	Status
	1052	Unsigned16	Transfer value	Mode (Px.113000)

Method	PNU	Data type	Function	Description
	1053	Unsigned1 6	Return value	Return code

Tab. 26 Position capture (touch probe) 1

9.1.1.2.10 Modulo operation

CiA402

Method	Object	Data type	Function	Description
Modulo	0x2008.01	USINT	Control	Value = 1: execute method Value = 0: reset method
	0x2008.02	USINT	Status	Status
	0x2008.03	UINT	Transfer value	Modulo mode – 0 = modulo positioning off (OFF) – 1 = shortest path – 3 = shortest path with reference to modulo limits – 4 = positive direction – 6 = negative direction – 8 = Set modulo position – 9 = Reset modulo position
	0x2008.04	UINT	Return value	Return code

Tab. 27 Modulo operation

PROFIdrive

Method	PNU	Data type	Function	Description
Modulo	10010	Unsigned8	Control	Value = 1: execute method Value = 0: reset method
	10011	Unsigned8	Status	Status
	10012	Unsigned1 6	Transfer value	Modulo mode – 0 = modulo positioning off (OFF) – 1 = shortest path – 3 = shortest path with reference to modulo limits – 4 = positive direction – 6 = negative direction – 8 = Set modulo position – 9 = Reset modulo position
	10013	Unsigned16	Return value	Return code

Tab. 28 Modulo operation

9.1.2 Fundamentals of parameterization

9.1.2.1 View of the parameters

Structure of the parameter IDs

All parameter IDs consist of the following 5 components for unique identification of the parameters:

P	System/ axis	Number	Instance	Index
.	.	.	.	[5] ➔ Identification of the differentiation of similar parameters within an instance, e.g. record type: 0 = record 1 1 = record 2 2 = record 3
.	.	.	[4] ➔	Identifier for distinguishing similar parameters of several components, e.g.: 0 = encoder 1 1 = encoder 2
.	.	[3] ➔	ID number of the parameter	
.	[2] ➔	Identification of system or axis parameters: 0 = system x = number of the related axis (1 = axis 1, 2 = axis 2, ...)		
[1] ➔	Identification P = parameter			

Tab. 29

Parameter ID					Description
[1]	[2]	[3]	[4]	[5]	
P	0.	10040.	0.	0	

Tab. 30 Example of parameter ID encoder resolution

Parameter ID					Description
[1]	[2]	[3]	[4]	[5]	Axis parameter "Record number" (ID P1.1811) Data record for axis 1 Index = 0 -› record number of the 1st internal data record
P	1.	1811.	0.	0	
P	1.	1811.	0.	2	Data record for axis 1 Index = 2 -› record number of the 3rd internal data record

Tab. 31 Example of parameter ID record number

Functional description in parameter tables

The description of the parameters included in the scope of functions is provided via parameter tables with the following structure:

ID Px.	Parameter	Description		
8416 [1]	Axis zero point offset [2]	Specifies the offset of the HEPP/axis zero point to the reference mark.		[3]
		Access	read/write	[4]
		Update	effective immediately	[5]
		Unit	user defined	[6]

Tab. 32 Sample representation using the example of the HEPP/axis parameter ID Px.8416

No.	Description
[1]	Number of the system or axis parameter
[2]	Name of the system or axis parameter
[3]	Brief description of the parameter, optional: additional information on the parameter, e.g. value list for instance/index of the parameter ID
[4]	Optional access to the parameter: – Access: read The parameter setting can be evaluated. – Access: read/write The parameter setting can be evaluated and changed.
[5]	Measure for updating the function when the parameter is changed – Update: effective immediately Modification of the parameter takes effect immediately, without ‹Reinitialize› or ‹Restart device›. – Update: reinitialization Changing the parameter takes effect after a ‹Reinitialize›. – Update: restart Changing the parameter takes effect after a ‹Restart device›.
[6]	Information on the unit of measurement of the parameter: – Unit: — The parameter has no unit of measurement. – Unit: user-defined The parameter has a configurable measuring unit. Typical for movement variables position, velocity, acceleration or jerk corresponding to the parameterization (➔ Px.1150.0.0, Current user unit). – Unit: Nm, kg, s ... The measurement unit of the parameter cannot be configured and is displayed explicitly

Tab. 33 Explanation of the sample display

9.1.2.2 Data types

Data types used and their value ranges:

Data type PN / EP	Data type EC	Variable and sign	Value range
Boolean	BOOL	8-bit without sign	0 ... 255
Unsigned8	USINT	8-bit without sign	0 ... 255
Integer8	SINT	8-bit with sign	–128 ... 127
Unsigned1 6	UINT	16-bit without sign	0 ... 65536
Integer16	INT	16-bit with sign	–32768 ... 32767
Unsigned3 2	UDINT	32-bit without sign	0 ... (232 –1)
Integer32	DINT	32-bit with sign	–231 ... (232 –1)
Unsigned6 4	ULINT	64-bit without sign	0 ... (264 –1)
Integer64	LINT	64-bit with sign	–263 ... (264 –1)
Floating- Point	REAL	32-bit with floating decimal	1.17 * 10–38 ... 3.4 * 1038
Floating- Point64	LREAL	64-bit with floating decimal	2.2 * 10–308 ... 1.8 * 10308
Visible String	STRING(X)	X * 8-bit without sign	X * 0 ... 255

Tab. 34 Data types

9.1.2.3 View of the objects specific to the device profile

The function descriptions in the profile-specific section contain tables in which the profile-specific objects or parameters assigned to the relevant parameters are listed.

Structure of the CiA object tables

In the device-specific section, the function descriptions contain tables in which objects allocated to the parameters involved are listed.

The CiA object tables are structured as follows in the descriptions of the individual functions:

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective. [1]		
468	0x6068.00	Damping time target reached	UINT
469	0x6067.00	Monitoring window target position	UDINT
4610	0x606D.00	Monitoring window target velocity	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective. [2]		
468	0x2166.09	Damping time target reached	REAL
469	0x2166.0A	Monitoring window target position	REAL
4610	0x2166.0B	Monitoring window target velocity	REAL
4611	0x2166.0C	Monitoring window target torque	REAL
[3]	[4]	[5]	[6]

Tab. 35 Example of object table

Cell	Content/description
1	Range for CiA 402 objects: only the parameters that are allocated to an object of the standard device profile for HEPPs.
2	Range for manufacturer-specific objects: all parameters are allocated to an object in the manufacturer-specific range
3	Parameter number
4	Allocated index and sub-index (hexadecimal)
5	Name of the parameter
6	Data type of the object; may differ from the data type of the parameter Recomm. maximum

Tab. 36 Legend for the example of object table

Structure of the PNU parameter tables

The PNU parameter tables are structured as follows in the descriptions of the individual functions:

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters** 1		
11280606	36.0	Acceleration MDI	Integer16
11280607	37.0	Deceleration MDI	Integer16
11280604	34.0	Target position MDI	Integer32
11280605	35.0	Profile velocity MDI	Unsigned32
Px.	**Manufacturer-specific parameters** 2		
11280606	12341.0	Acceleration MDI	FloatingPoint
11280607	12342.0	Deceleration MDI	FloatingPoint
11280604	12339.0	Target position MDI	Integer64
11280605	12340.0	Profile velocity MDI	FloatingPoint
...	...	...	...
3	4	5	6

Tab. 37 Examples of PNUs

Cell	Content/description
1	Range for profile-specific PNUs: only the parameters that are allocated to PNUs of the PROFIdrive device profile.
2	Range for manufacturer-specific PNUs: parameters are allocated to the PNUs from the manufacturer-specific range.
3	Parameter number
4	Assigned PNU (decimal)
5	Name of the parameter
6	Data type of the PNU; can differ from the data type of the parameter

Tab. 38 Legend for the PNU table example

9.1.2.4 Measuring units

9.1.2.4.1 Defined measuring units

Basic units are defined measuring units in the HEPP gripper that typically characterize physical properties. These units cannot be changed by users.

Size	Basic unit	Data type		
Temperature	T	Degrees Celsius	°C	FLOAT32
Current	I	Ampere	A	FLOAT32
Voltage	r	Volt	V	FLOAT32
Energy	E	Joule/Watt second	J/Ws	FLOAT32
Torque	M	Newton-meter	Nm	FLOAT32
Resistance (electrical)	R	Ohm	Ω	FLOAT32
Inductance	L	Henry	H	FLOAT32
Capacity (electrical)	C	Farad	F	FLOAT32
Power	P	Watt	W	FLOAT32
Time	t	Second	s	FLOAT32
Value specification in per cent	%	—	—	FLOAT32

Tab. 39 Basic units

9.1.2.4.2 Configurable measuring units ("user unit")

Configurable units adapted to the respective application by the user are typically required for motion variables. They generally refer to the output side motion variables. The user units can only be converted in the "pre-operational" state and the conversion requires a reinitialization of the HEPP gripper. As a result, all the relevant parameters in the HEPP gripper are converted to the new user unit. The controller parameters do require recalculation during a conversion of the units. The configured user unit also applies for the HEPP profile. A conversion of the measuring unit using the HEPP profile also converts the unit of the entire device.

Measuring units (position)		Decimal places	Data type
Meter	m	10	SINT64

Tab. 40 Configurable measuring units of the position

All measuring units for the position are shown and preset with the SINT64 data type. The position is shown with a different number of decimal places in every measuring unit.

Examples for showing of positions

– $m \times 10^{10} \triangleq 1 \times 10^{7}$

All position differences and derivations from the position are displayed as FLOAT32 values in the device. As a result, a resolution (decimal place) does not have to be taken into consideration.

Variables/measuring units	Position difference	Velocity	Acceleration	Jerk	Data type
Meter	m	m/s	m/s^2	m/s^3	FLOAT32

1) Default

Tab. 41 Configurable measuring units of the position difference and derived variables of the position

In user parameter sets, parameters are always saved in the unit set by the user. When a user unit is set, the derived variable obtains the same length reference (m, m/s, m/s², etc.).

Parameters for the configurable measuring units

ID Px.	Parameter	Description	
1150	Current user unit	Specifies the active user unit.	
		Access	read/–
		Update	effective immediately
		Unit	–
1151	Selection of next user unit	– 6: Metric [m, m/s, ...]	
		Access	read/write
		Update	reinitialization
		Unit	–
1152	User unit status	Specifies whether the user unit is active	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 42 Parameter

CiA 402

Objects for the configurable measuring units

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
1150	0x217C.01	Current user unit	UDINT
1151	0x217C.02	Selection of next user unit	UDINT
1152	0x217C.03	User unit status	UDINT

Tab. 43 Objects

PROFIdrive

PNUs for the configurable measuring units

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
1150	11277.0	Current user unit	Unsigned32
1151	11278.0	Selection of next user unit	Unsigned32
1152	11279.0	User unit status	Unsigned32

Tab. 44 PNUs

9.1.2.5 Dimension reference system

9.1.2.5.1 Function

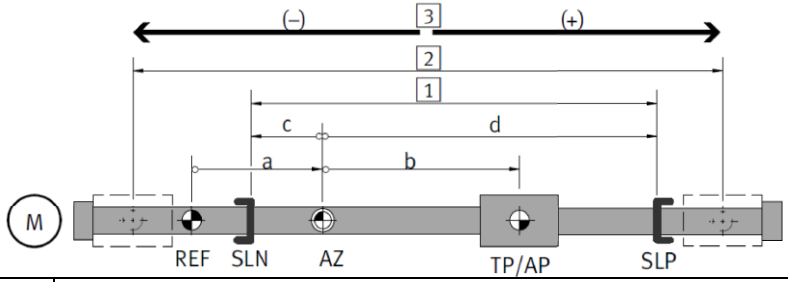
The correct positioning of the HEPP gripper requires a defined dimension reference system. To define the measuring reference system, the following steps must be taken during first-time commissioning:

– Defining the HEPP/axis zero point
– Limitation of the usable range by software end positions and/or limit switches
– Determine the reference point with a homing run and move the factory-set zero point of the absolute encoder

Signs and directions in the measuring reference system

Linear measuring reference system

Example: linear HEPP



REF	Homing point (Reference Point)
AZ	HEPP zero point (Axis Zero Point)
TP	Target position (Target Position)
AP	Actual position/current position (Actual Position)
a	HEPP/axis zero point offset (AZ)
b	Target/actual position (TP/AP)
1	Usable range (Usable stroke)
2	Working area (Working stroke)
3	Direction of movement with the factory setting

Tab. 45 Linear measuring reference system

Reference point	Calculation rule		
HEPP/axis zero point	AZ	= REF + a	
Target position/actual position	TP/AP	= AZ + b	= REF + a + b

Tab. 46 Linear measuring reference system – calculation rule

The various positions are specified according to the configured user unit. On conversion of the user unit, the variables are converted automatically ➔ 9.1.2.4 Measuring units.

Limitation of the usable range

The usable range can be limited by software end positions.

9.1.3 HEPP gripper configuration

9.1.3.1 Brake control

9.1.3.1.1 Function

There are two different kinds of HEPP grippers, one with an integrated brake, the other without. The following content is only for HEPP grippers with an integrated brake
The mechanical delay of the brakes means that it takes a certain length of time to release and activate them. The behavior of the device can be adapted to the mechanical delay of the brake by using parameters:

Parameter	Description
Switch-on delay	Delay in switching on the closed-loop controller until an order is accepted – The holding brake is not released until the controller is enabled. The closed- loop controller takes over the control (actual position = setpoint position). – No orders are processed until the switch-on delay has elapsed, so the holding brake can release completely. – After the switch-on delay has elapsed, orders are accepted.
Switch-off delay	Delay prior to shut-down of the closed-loop controller: – Removal of the controller enable triggers a category 1 stop. If the setpoint rotational speed is 0, the signal for closing the holding brake is given. – The HEPP gripper is maintained in its current position until the switch-off delay has elapsed. – The closed-loop controller is switched off after the switch-off delay has elapsed.

Tab. 47 Switch-on and switch-off delay

Control of the brake

Control of the brakes	
Event	**Behavior**
The controller enable (RF) is rescinded	– Stop category 1 – The closed-loop controller is switched off when the parameterized delay has elapsed to prevent unwanted movement of the HEPP gripper.
The controller enable (RF) is granted	– The position controller assumes the control (actual position = setpoint position). – The motion commands are not accepted until the parameterized delay has elapsed.

Tab. 48 Control of the brakes

Manual release of the holding brake or clamping unit

If the controller release is withdrawn, the output is reset and the holding brake is actuated. The holding brake can be released manually in this status.

When the brakes are released manually, suspended loads generally drop.

Manual release through ...	Description
Open holding brake input (configurable)	The holding brake is released at a high level or low level depending on the parameterized switching function ➔ 9.1.3.1.2 Parameters and diagnostic messages.
Device profile	➔ 9.1.3.1.3 CiA 402 ➔ 9.1.3.1.4 PROFIdrive

Tab. 49 Releasing the holding brake

When the closed-loop controller is released again, the output is controlled as required for the active operating mode. Another rescinding of the controller enable will actuate the holding brakes ➔ Tab. 48 Control of the brakes.
In order to release the holding brake again, a new level change from low to high is required.

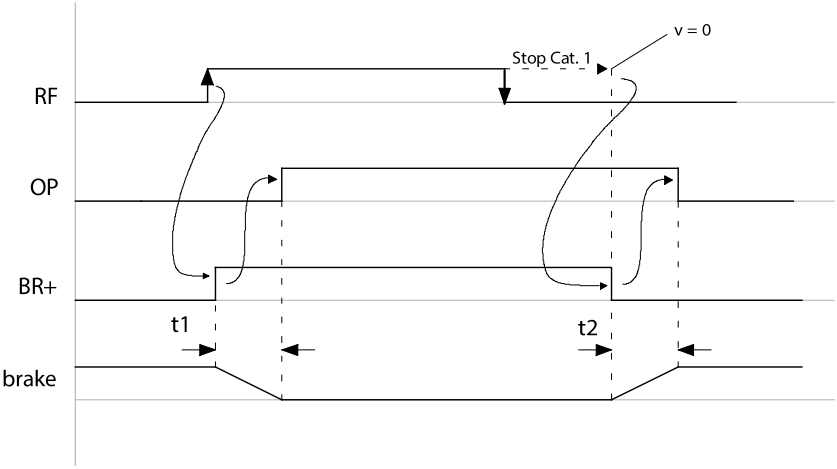


Fig. 10 Brake control timing (example)

Name	Description
RF	Controller enable signal
OP	Motion commands are accepted
Brake	Mechanical behavior of brake (released and set)
t1	Delay time depending on the parameterized switch-on delay
t2	Delay time depending on the parameterized switch-off delay

Tab. 50 Legend for the brake control timing image (example)

Holding current reduction

The HEPP gripper has a voltage reduction for the holding brake. The holding current reduction is activated with Px.40001.
If the function of the holding current reduction is not activated, the voltage is output t o open the holding brake.
If the function of the holding current reduction is activated, after the holding brake has been opened, the voltage is first output and after a delay time of Px.40002 the voltage reduction is performed to the parameterized voltage value.

9.1.3.1.2 Parameters and diagnostic messages

ID Px.	Parameter	Description	
20	Switch-on delay holding brake 1	Determines how long the next command is delayed after a controller enable. No commands are processed until the switch-on delay has elapsed so that holding brake 1 can release completely.	
		Access	read/–
		Update	effective immediately
		Unit	s
21	Switch-off delay holding brake 1	Determines how long the closed-loop controller shall hold the current position so that the holding brake can be closed completely. The position controller is switched off after expiration of the switch-off delay. Holding brake 1 should then be completely closed.	
		Access	read/–
		Update	effective immediately
		Unit	s
24	Status holding brake 1	Specifies the status of the corresponding holding brake. Possible status ➔ Tab. 52 Holding brake status parameter values list.	
		Access	read/–
		Update	effective immediately
		Unit	–
29	Selection of holding brake	Selecting the holding brake for manual opening and for the automatic brake test 0: holding brake 1	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 51 Parameter

Value	Status	Description
0	Closed	The holding brake is closed
1	Open	The holding brake is open
2	Opened	Holding brake is being opened
3	Closed	Holding brake is being closed

Tab. 52 Holding brake status parameter values list

Diagnostic messages

No specific diagnostic messages are allocated to the function

9.1.3.1.3 CiA 402

Holding brake objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
20	0x2150.01	Switch-on delay holding brake 1	REAL
21	0x2150.02	Switch-off delay holding brake 1	REAL
24	0x2150.05	Status holding brake 1	UDINT
29	0x2150.09	Selection of holding brake	UDINT
7162	0x216C.0F	Switch-on delay holding brake (user defined)	REAL
7165	0x216C.10	Switch-off delay holding brake (user defined)	REAL
7163	0x2162.12	Current switch-on delay holding brake	REAL
7166	0x2162.13	Current switch-off delay holding brake	REAL
7161	0x2106.2B	Switch-on delay holding brake	REAL
7164	0x2106.2D	Switch-off delay holding brake	REAL
40001	0x21A7.01	Activation current reduction holding brake	BOOL
40002	0x21A7.02	Delay time	REAL

Tab. 53 Objects

9.1.3.1.4 PROFIdrive

Holding brake PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
20	11002.0	Switch-on delay holding brake 1	FloatingPoint
21	11003.0	Switch-off delay holding brake 1	FloatingPoint
24	11006.0	Status holding brake 1	Unsigned32
29	11011.0	Selection of holding brake	Unsigned32
7162	11716.0	Switch-on delay holding brake (user defined)	FloatingPoint
7165	11718.0	Switch-off delay holding brake (user defined)	FloatingPoint
7163	11717.0	Current switch-on delay holding brake	FloatingPoint
7166	11719.0	Current switch-off delay holding brake	FloatingPoint
7161	2755.0	Switch-on delay holding brake	FloatingPoint
7164	2757.0	Switch-off delay holding brake	FloatingPoint
40001	12409.0	Activation current reduction holding brake	Boolean
40002	12410.0	Delay time	FloatingPoint

Tab. 54 PNUs

9.1.3.2 Encoder configuration

9.1.3.2.1 Function

The HEPP gripper has an integrated encoder that supports the SSI protocol.

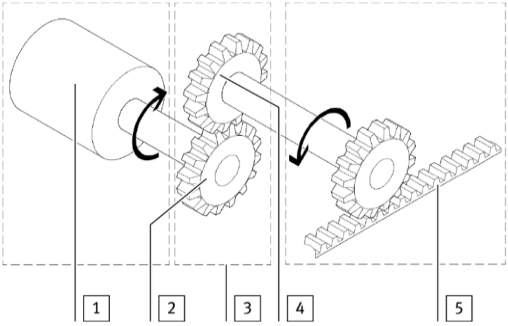
9.1.3.2.2 Parameters of the commutation angle detection

Commutation-angle detection is normally not required. If no valid commutation angle has been found in the current data record, the commutation-angle detection is performed automatically. A commutation-angle detection is performed once in the switch-on phase for encoders that do not provide an absolute position on a revolution. If a commutation-angle detection is required, the friction of the HEPP system must not be too high. The motor shaft should be freely rotating during the commutation- angle detection.
When the commutation-angle detection is started, the HEPP gripper is moved to the magnetic zero position. A reactive current is injected for this purpose (Px.270). The reactive current should not be higher than the minimum from the maximum values of the HEPP gripper (Px.624).
The HEPP gripper then begins to move in the positive direction around the magnetic zero position at the parameterized increment (Px.664) for 2 * increments and then in the negative direction for 3 * increments. The increment is specified as the electrical angle, e.g. B. 90 °. For a motor with a pool pair number of 5, there is a mechanical movement at the output of 0.05 revolutions. If the expected position change is outside the monitoring window, a second attempt is made to retract the HEPP gripper. If the expected position change is exceeded again, an error message is issued (Px.6693).
The commutation angle detection is strongly influenced by the dynamic values and the waiting time for the position check. In the event of an error, the dynamic values should be reduced and the waiting time increased.After a successful commutation-angle detection, the parameter set must be saved on the device.

9.1.3.3 Gear unit

9.1.3.3.1 Function

The device supports the use of several gear units within a drive chain. The correct transmission ratio for each gear unit used must be specified during configuration. The transmission ratio is specified using the gear ratio. The gear ratio consists of a numerator and denominator. The numerator indicates the number of revolutions on the drive side of the gear unit and the denominator indicates the number of resulting revolutions on the output side of the gear unit.



1 Motor shaft
2 Drive side
3 Gear unit
4 Output side
5 Axis

Fig. 11 Gear ratio (example)

Parameters of gear ratio groups 0, 1, 2
The device offers 3 gear ratio groups. A gear ratio and a feed constant can be set for each gear ratio group.

Users should not change the parameters of the gear units.

9.1.4 Protective functions

9.1.4.1 I²t monitoring of the power output stage

The "I²t monitoring power output stage" protective function is used to protect the power output stage from thermal material damage due to excessive dissipation of electrical energy.
In the process, the limit values of a specific warning threshold and upper limit are monitored. When the specified limit value is reached, a diagnostic message is triggered. After the upper limit is reached, the current is limited to the nominal current. The limitation to the nominal current is automatically rescinded when the integrator value of the I²t monitoring is set to 0.
An electrical rotational frequency ≤ 5 Hz at the output of the power output stage is monitored by a short I²t time and separate diagnostic messages.

Users should not change the parameters.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
637	Scaling factor start value I²t monitoring power output stage	Specifies the scaling factor for the start value based on the limit value of the I²t monitoring of the power output stage at standstill.	
		Access	read/–
		Update	effective immediately
		Unit	–
638	Limit value I²t monitoring power output stage	Specifies the limit value for I²t monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	A²s
639	Scaling factor maximum value after switching on	Displays the scaling factor for the maximum value based on the limit value after switching on.	
		Access	read/–

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
6310	Actual value I²t monitoring power output stage	Specifies the actual value for I²t monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	A²s
6311	Scaling factor warning limit I²t monitoring power output stage	Specifies the scaling factor for the warning limit based on the limit value of the I²t monitoring of the power output stage.	
		Access	read/write
		Update	effective immediately
		Unit	–
6313	Scaling factor start value I²t monitoring power output stage at standstill	Specifies the scaling factor for the start value based on the limit value of the I²t monitoring of the power output stage at standstill.	
		Access	read/–
		Update	effective immediately
		Unit	–
6314	Limit value I²t monitoring power output stage at standstill	Specifies the limit value for I²t monitoring of the power output stage at standstill.	
		Access	read/–
		Update	effective immediately
		Unit	A²s
6315	Scaling factor maximum value after drive at standstill	Displays the scaling factor for the maximum value based on the limit value, after the HEPP drive is at standstill.	
		Access	read/–
		Update	effective immediately
		Unit	–
6316	Actual value I²t monitoring power output stage at standstill	Specifies the actual value for I²t monitoring of the power output stage at standstill.	
		Access	read/–
		Update	effective immediately
		Unit	A²s
6317	Scaling factor warning limit I²t monitoring drive at standstill	Specifies the scaling factor for the warning limit based on the limit value of the I²t monitoring of the power output stage if the HEPP drive is at standstill.	
		Access	read/write
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
6332	Actual value relative I²t monitoring of power output stage to limit	Specifies the actual value for relative I²t monitoring of the power output stage to the limit.	
		Access	read/–
		Update	effective immediately
		Unit	–
6333	Actual value relative I²t monitoring of power output stage at standstill to limit	Specifies the actual value for relative I²t monitoring of the power output stage at standstill to the limit.	
		Access	read/–
		Update	effective immediately
		Unit	–
6334	Actual value I²t monitoring of the total current	Specifies the current actual value of the I²t monitoring of the total current.	
		Access	read/–
		Update	effective immediately
		Unit	Arms

Tab. 55 Parameters of "I²t monitoring of power output stage"

ID Dx.	Name	Description
01 | 02 | 00014 (16908302)	I²t monitoring: output stage warning limit	I²t monitoring: output stage warning limit
01 | 02 | 00015 (16908303)	I²t monitoring: output stage error limit	I²t monitoring: output stage error limit
01 | 02 | 00016 (16908304)	I²t monitoring: output stage v0 warning limit	I²t monitoring: output stage in standstill warn ing limit
01 | 02 | 00017 (16908305)	I²t monitoring: output stage v0 error limit	I²t monitoring: output stage in standstill error limit

Tab. 56 Diagnostic messages of "I²t monitoring of the power output stage"

9.1.4.1.1 CiA402

Objects of "I²t monitoring of the power output stage"

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
637	0x216A.07	Scaling factor start value I²t monitoring power output stage	REAL
638	0x216A.08	Limit value I²t monitoring power output stage	REAL
639	0x216A.09	Scaling factor maximum value after switching on	REAL
6310	0x216A.0A	Actual value I²t monitoring power output stage	REAL
6311	0x216A.0B	Scaling factor warning limit I²t monitoring power output stage	REAL

Parameter	Index.Subindex	Name	Data type
6313	0x216A.0C	Scaling factor start value I²t monitoring power output stage at standstill	REAL
6314	0x216A.0D	Limit value I²t monitoring power output stage at standstill	REAL
6315	0x216A.0E	Scaling factor maximum value after the drive at standstill	REAL
6316	0x216A.0F	Actual value I²t monitoring power output stage at standstill	REAL
6317	0x216A.10	Scaling factor warning limit I²t monitoring drive at standstill	REAL
6332	0x216A.1E	Actual value relative I²t monitoring of power output stage to limit	REAL
6333	0x216A.1F	Actual value relative I²t monitoring of power output stage at standstill to limit	REAL
6334	0x216A.20	Actual value I²t monitoring of the total current	REAL

Tab. 57 Objects

9.1.4.1.2 PROFIdrive

PNUs of the I²t monitoring of the power output stage

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
637	11174.0	Scaling factor start value I²t monitoring power output stage	FloatingPoint
638	11175.0	Limit value I²t monitoring power output stage	FloatingPoint
639	11176.0	Scaling factor maximum value after switching on	FloatingPoint
6310	11655.0	Actual value I²t monitoring power output stage	FloatingPoint
6311	11656.0	Scaling factor warning limit I²t monitoring power output stage	FloatingPoint
6313	11657.0	Scaling factor start value I²t monitoring power output stage at standstill	FloatingPoint
6314	11658.0	Limit value I²t monitoring power output stage at standstill	FloatingPoint
6315	11659.0	Scaling factor maximum value after the drive at standstill	FloatingPoint
6316	11660.0	Actual value I²t monitoring power output stage at standstill	FloatingPoint
6317	11661.0	Scaling factor warning limit I²t monitoring the drive at standstill	FloatingPoint
6332	11675.0	Actual value relative I²t monitoring of power output stage to limit	FloatingPoint
6333	11676.0	Actual value relative I²t monitoring of power output stage at standstill to limit	FloatingPoint

Parameters	PNU	Name	Data type
6334	11677.0	Actual value I²t monitoring of the total current	FloatingPoint

Tab. 58 PNUs

9.1.4.2 I²t monitoring of motor

A simplified thermal motor model is used for the HEPP gripper to protect the integrated motor from thermal overload. The simplified thermal motor model is based on a deceleration member of the first order with a standardized status variable of 0 to 1 and a parameterizable filter time constant of If the deceleration member reaches the value 1, this means that the motor is permanently operated with nominal current. If the value 1.05 of the status variable is reached, a diagnostic message is emitted. Between 0 and 1, a warning threshold can be parameterized.

Timing

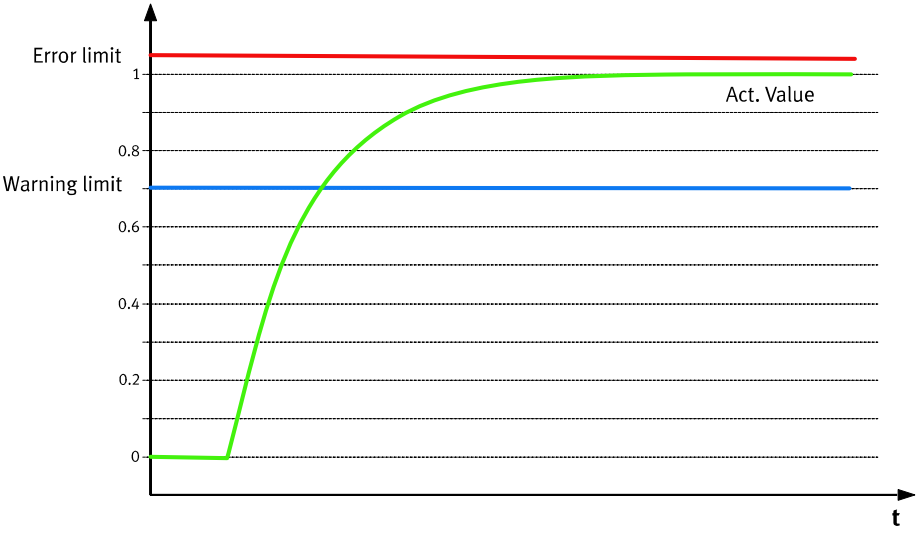


Fig. 12 Timing of I²t monitoring of motor

Name	Description
Error limit	Px.6306, limit value I²T monitoring motor model
Warning limit	Px.6305, scaling factor warning limit I²t monitoring motor model
Act. Value	Px.6302, actual value I²T monitoring motor model

Tab. 59 Legend for timing of I²t monitoring of motor

Parameters and diagnostic messages

ID Px.	Parameter	Description	
6302	Actual value I²T monitoring motor	Displays the actual value of I²t monitoring from the motor model.	
		Access	read/–

ID Px.	Parameter	Description	
	model	Update	effective immediately
		Unit	–
6301	Scaling factor start value I²t monitoring motor model	Specifies the scaling factor for setting the start value for I²t monitoring based on the limit value of I²t monitoring of the motor model.	
		Access	read/write
		Update	effective immediately
		Unit	–
6305	Scaling factor warning limit I²t monitoring motor model	Specifies the scaling factor for setting the warning limit for I²t monitoring based on the limit value of I²t monitoring of the motor model.	
		Access	read/write
		Update	effective immediately
		Unit	–
6303	Maximum start value I²t monitoring motor model	Specifies the maximum permissible start value of I²t monitoring of the motor model.	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 60 Parameters of I²t monitoring of motor

ID Dx.	Name	Description
01 | 02 | 00259 (16908547)	I²t monitoring: motor model error limit	I²t monitoring: motor model error limit
01 | 02 | 00258 (16908546)	I²T monitoring: motor model warning limit	I²T monitoring: motor model warning limit

Tab. 61 Diagnostic messages of I²t monitoring of the motor

9.1.4.2.1 CiA 402

Objects of I²t monitoring of the motor

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
6302	0x21A5.02	Actual value I²T monitoring motor model	REAL
6301	0x21A5.01	Scaling factor start value I²t monitoring motor model	REAL
6305	0x21A5.04	Scaling factor warning limit I²t monitoring motor model	REAL
6303	0x21A5.03	Maximum start value I²t monitoring motor model	REAL

Tab. 62 Objects

9.1.4.2.2 PROFIdrive

PNUs of I²t monitoring of motor

Parameter	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
6302	12405.0	Actual value I²T monitoring motor model	FloatingPoint
6301	12404.0	Scaling factor start value I²t monitoring motor model	FloatingPoint
6305	12407.0	Scaling factor warning limit I²t monitoring motor model	FloatingPoint
6303	12406.0	Maximum start value I²t monitoring motor model	FloatingPoint

Tab. 63 PNUs

9.1.4.3 Temperature monitoring of the HEPP gripper

The "Temperature monitoring HEPP gripper" protective function protects the power module from overtemperature.
The upper and lower limit values of a certain warning threshold and of a certain upper and lower limit are monitored, including hysteresis. The hysteresis is 5 °C. When the respective limit value is reached, a diagnostic message is triggered. The diagnostic message can only be acknowledged if the temperature has left the threshold or the limit including the hysteresis range.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
920	Temperature power output stage	Specifies the current actual temperature value of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	°C
921	Temperature status power output stage	Specifies the status of the temperature monitoring of the power output stage	
		Access	read/–
		Update	effective immediately
		Unit	–
9314	Upper limit value warning threshold power output stage temperature	Determines the upper limit value of warning threshold for the temperature monitoring of the power output stage.	
		Access	read/write
		Update	effective immediately
		Unit	°C
9315	Upper limit value power output stage temperature	Determines the upper limit value of the temperature monitoring of the power output stage.	
		Access	read/write
		Update	effective immediately
		Unit	°C

ID Px.	Parameter	Description	
9316	Lower limit value warning threshold power output stage temperature	Determines the lower limit value of warning threshold for the temperature monitoring of the power output stage.	
		Access	read/write
		Update	effective immediately
		Unit	°C
9317	Lower limit value power output stage temperature	Determines the lower limit value of the temperature monitoring of the power output stage.	
		Access	read/write
		Update	effective immediately
		Unit	°C
9322	Current upper limit value warning threshold power output stage temperature	Specifies the current upper limit value of the warning threshold for the temperature monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	°C
9323	Current upper limit value power output stage temperature	Specifies the current upper limit value of the temperature monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	°C
9324	Current lower limit value warning threshold power output stage temperature	Specifies the current lower limit value of the warning threshold for the temperature monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	°C
9325	Current lower limit value power output stage temperature	Specifies the current lower limit value of the temperature monitoring of the power output stage.	
		Access	read/–
		Update	effective immediately
		Unit	°C

Tab. 64 Parameters of “Temperature monitoring of the HEPP gripper”

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.1.4.3.1 CiA 402

Objects of “Temperature monitoring of the HEPP gripper”

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
920	0x2128.01	Temperature power output stage	REAL
921	0x2128.02	Temperature status power output stage	DINT
9314	0x2128.19	Upper limit value warning threshold power output stage temperature	REAL
9315	0x2128.1A	Upper limit value power output stage temperature	REAL
9316	0x2128.1B	Lower limit value warning threshold power output stage temperature	REAL
9317	0x2128.1C	Lower limit value power output stage temperature	REAL
9322	0x2128.21	Current upper limit value warning threshold power output stage temperature	REAL
9323	0x2128.22	Current upper limit value power output stage temperature	REAL
9324	0x2128.23	Current lower limit value warning threshold power output stage temperature	REAL
9325	0x2128.24	Current lower limit value power output stage temperature	REAL

Tab. 65 Objects

9.1.4.3.2 PROFIdrive

PNUs "temperature monitoring of the HEPP gripper"

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
920	2246.0	Temperature power output stage	FloatingPoint
921	2247.0	Temperature status power output stage	Integer32
9314	2795.0	Upper limit value warning threshold power output stage temperature	FloatingPoint
9315	2796.0	Upper limit value power output stage temperature	FloatingPoint
9316	2797.0	Lower limit value warning threshold power output stage temperature	FloatingPoint
9317	2798.0	Lower limit value power output stage temperature	FloatingPoint
9322	2803.0	Current upper limit value warning threshold power output stage temperature	FloatingPoint
9323	2804.0	Current upper limit value power output stage temperature	FloatingPoint

Parameters	PNU	Name	Data type
9324	2805.0	Current lower limit value warning threshold power output stage temperature	FloatingPoint
9325	2806.0	Current lower limit value power output stage temperature	FloatingPoint

Tab. 66 PNUs

9.1.4.4 System monitoring

The protective function monitors the internal system during initialization and runtime. It is used to protect the control unit. If a system error is detected, the power output stage is switched off and the HEPP gripper is put in an operationally safe condition. A system error can be eliminated by restarting the HEPP gripper.

9.1.4.5 Mains and DC link monitoring

9.1.4.5.1 Mains voltage monitoring

The mains monitoring protective function is used to protect against mains failure, undershooting or exceeding the mains voltage.
When the respective limit value is undershot or exceeded over a certain period of time, a diagnostic message is triggered. The HEPP gripper tolerates a short-term interruption of the mains voltage. The tolerance time is device-specific and cannot be changed by the user.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
491	Load voltage root mean square value	Specifies the load voltage root mean square value.	
		Access	read/–
		Update	effective immediately
		Unit	V
493	Lower load voltage limit value	Determines the lower limit value for load voltage monitoring.	
		Access	read/write
		Update	effective immediately
		Unit	V
494	Upper load voltage limit value	Determines the upper limit value for load voltage monitoring.	
		Access	read/write
		Update	effective immediately
		Unit	V
28151	Current lower limit value load voltage	Specifies the lower limit value for load voltage monitoring.	
		Access	read/–
		Update	effective immediately
		Unit	V

ID Px.	Parameter	Description	
28152	Current upper limit value load voltage	Specifies the upper limit value for load voltage monitoring.	
		Access	read/–
		Update	effective immediately
		Unit	V

Tab. 67 Mains voltage monitoring parameter

ID Dx.	Name	Description
02 I 03 I 00038 (33751078)	Undervoltage in load voltage	Undervoltage in load voltage
02 I 03 I 00039 (33751079)	Overvoltage in load voltage	Overvoltage in load voltage

Tab. 68 Mains voltage monitoring diagnostic messages

CiA 402

Mains voltage monitoring objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
490	0x2115.01	Load voltage peak value	REAL
491	0x2115.02	Load voltage root mean square value	REAL
492	0x2115.03	Actual rectified load voltage value	REAL
493	0x2115.04	Lower load voltage limit value	REAL
494	0x2115.05	Upper load voltage limit value	REAL
495	0x2115.06	Actual load voltage frequency value	REAL
4995	0x2115.12	Status load voltage	BOOL
5113	0x2115.15	Activation DC voltage supply	BOOL
28140	0x2115.17	Load voltage frequency minimum	REAL
28150	0x2115.18	Maximum load voltage frequency	REAL
28151	0x2115.19	Current lower limit value load voltage	REAL
28152	0x2115.1A	Current upper limit value load voltage	REAL

Tab. 69 Objects

PROFIdrive

Mains voltage monitoring PNUs

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
490	2156.0	Load voltage peak value	FloatingPoint
491	2157.0	Load voltage root mean square value	FloatingPoint
492	2158.0	Actual rectified load voltage value	FloatingPoint

Parameters	PNU	Name	Data type
493	2159.0	Lower load voltage limit value	FloatingPoint
494	2160.0	Upper load voltage limit value	FloatingPoint
495	2161.0	Actual load voltage frequency value	FloatingPoint
4995	2549.0	Status load voltage	Boolean
5113	2552.0	Activation DC voltage supply	Boolean
28140	3050.0	Load voltage frequency minimum	FloatingPoint
28150	3051.0	Maximum load voltage frequency	FloatingPoint
28151	3052.0	Current lower limit value load voltage	FloatingPoint
28152	3053.0	Current upper limit value load voltage	FloatingPoint

Tab. 70 PNUs

9.1.4.5.2 Monitoring of the DC link voltage

The protective function is used to monitor the DC link voltage. In the process, the DC link voltage is monitored for a preset maximum value and parameterized minimum value. In addition, a limit value for the warning threshold can be parameterized. When the specified limit value is reached, a diagnostic message is triggered. If the maximum permissible DC link voltage exceeded, a category 0 stop is performed and the HEPP gripper slowly comes to a stop.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
480	Actual value DC link voltage	Specifies the current actual value of the DC link voltage.	
		Access	read/–
		Update	effective immediately
		Unit	V
4811	Warning threshold DC link voltage	Determine the warning threshold for the monitoring of the DC link voltage.	
		Access	read/write
		Update	effective immediately
		Unit	V
4813	Upper limit value DC link voltage	Determines the upper limit value for the monitoring of the DC link voltage.	
		Access	read/write
		Update	effective immediately
		Unit	V
4814	Lower limit value DC link voltage	Determines the lower limit value for the monitoring of the DC link voltage.	
		Access	read/write
		Update	effective immediately
		Unit	V

ID Px.	Parameter	Description	
56799	Current warning threshold DC link voltage	Specifies the currently used warning threshold for monitoring the DC link voltage.	
		Access	read/–
		Update	effective immediately
		Unit	V
56800	Current upper limit value DC link voltage	Specifies the currently used upper limit value for monitoring the DC link voltage.	
		Access	read/–
		Update	effective immediately
		Unit	V
56801	Current lower limit value DC link voltage	Specifies the currently used lower limit value for monitoring the DC link voltage.	
		Access	read/–
		Update	effective immediately
		Unit	V

Tab. 71 Parameters of “Monitoring of the DC link voltage”

ID Dx.	Name	Description
02 I 02 I 00030 (33685534)	Overvoltage in DC link	Overvoltage in DC link
02 I 02 I 00031 (33685535)	Undervoltage in DC link	Undervoltage in DC link
02 I 02 I 00032 (33685536)	DC link warning threshold reached	DC link warning threshold reached

Tab. 72 Diagnostic messages of “Monitoring of the DC link voltage”

CiA 402

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
480	0x6079.00	Actual value DC link voltage	UDINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
480	0x2114.01	Actual value DC link voltage	REAL
4811	0x2114.0A	Warning threshold DC link voltage	REAL
4813	0x2114.0C	Upper limit value DC link voltage	REAL
4814	0x2114.0D	Lower limit value DC link voltage	REAL
56799	0x2114.18	Current warning threshold DC link voltage	REAL
56800	0x2114.19	Current upper limit value DC link voltage	REAL
56801	0x2114.1A	Current lower limit value DC link voltage	REAL

Tab. 73 Objects of “Monitoring of the DC link voltage”

PROFIdrive

Parameter	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
480	2148.0	Actual value DC link voltage	FloatingPoint
4811	2533.0	Warning threshold DC link voltage	FloatingPoint
4813	2535.0	Upper limit value DC link voltage	FloatingPoint
4814	2536.0	Lower limit value DC link voltage	FloatingPoint
56799	3065.0	Current warning threshold DC link voltage	FloatingPoint
56800	3066.0	Current upper limit value DC link voltage	FloatingPoint
56801	3067.0	Current lower limit value DC link voltage	FloatingPoint

Tab. 74 PNUs of "monitoring of the DC link voltage"

9.2 Motion control

9.2.1 Operating modes

9.2.1.1 Finite state machine

The internal finite state machine defines how the available operating statuses of the device are changed.
If the device completes the start-up phase without error, it automatically switches to the Ready status. If the closed-loop controller and the power stage are enabled, depending on the parameterization the device automatically switches to the status Standstill or the status Profile. The required operating mode can be activated in the Standstill status, e.g. by the device profile.

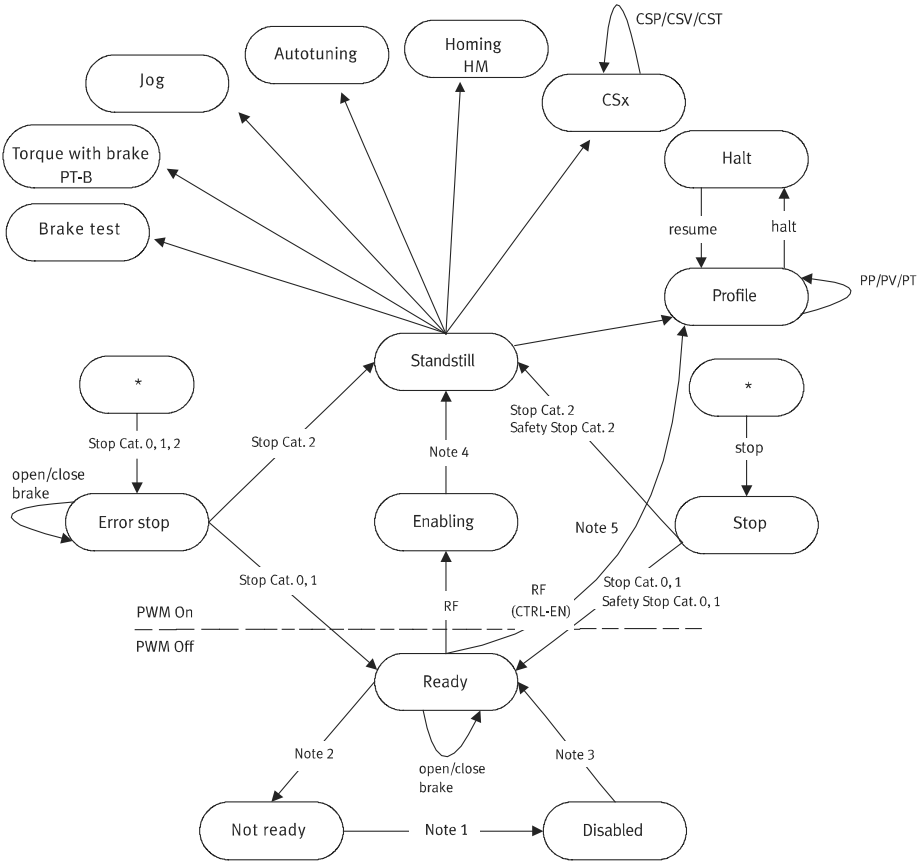


Fig. 13 Statuses and status transitions of the internal finite state machine

Statuses	Description
Not ready	The device is not ready because a precondition is not fulfilled, e.g. DC link voltage is not connected.
Disabled	The device is blocked. The power stage is locked and switched off.
Ready	The device is ready. The power stage is switched off. The brake can be set and released manually ➔ 9.1.3.1 Brake control.
Enabling	The power output stage is switched on.
Standstill	The device is ready for operation and it is position-controlled.
Homing	The device is running a homing movement ➔ 9.2.4 Homing.
Jog	The device is in jog mode ➔ 9.2.6 Jog mode.
Torque with brake	The device is running force or torque commands with set brake ➔ 9.2.1.5 Force/torque mode (PT) with or without holding brake.
Brake test	The device is running the automatic brake test ➔ 9.5.1.10 Brake test.
Profile	The device is running motion commands ➔ 9.2.1.2 Operating modes for performing motion commands.
Halt	The current order was aborted via the device profile ➔ 9.2.3 Hold.
Stop	The device was stopped by a stop signal ➔ 9.2.2 Stop.
Error stop	The device was stopped by a diagnostic event. The brake can be set and released manually ➔ 9.1.3.1 Brake control.

Tab. 75 Statuses of the internal finite state machine

Status transitions	Description
Note 1	The transition to the Not ready status occurs, e.g. if the connection to the encoder is interrupted or the reinitialization is requested or the intermediate circuit is not charged.
Note 2	Automatic transition to the Profile status if the power stage enable is exclusively via the CTRL-EN input
RF	Closed-loop controller and power stage enable
Stop Cat.	Stop of the corresponding category
Stop	Stop command via device profile or record table
Halt	Stop command via device profile
Resume	Resume command via device profile
PWM On	Power output stage is switched on
PWM Off	Power output stage is switched off

Tab. 76 Status transitions of the internal finite state machine

9.2.1.2 Operating modes for performing motion commands

The HEPP gripper has the following operating modes for performing motion commands:

Operating modes	Description
Profile operating modes – Positioning mode(PP) – Velocity mode (PV) – Force/torque mode (PT)	The HEPP gripper uses the integrated trajectory generator to generate the relevant setpoint quantities.
Cyclic synchronized ... – positioning mode (CSP) – velocity mode (CSV) – force/torque mode (CST)	The command values are specified at equidistant time points via fieldbus, e. g. via EtherCAT. The time-equidistant command values are input by a fine interpolator of the closed-loop controller.

Tab. 77 Operating modes for performing motion commands

- The cyclically synchronized operating modes are only available in the CiA402 profile.

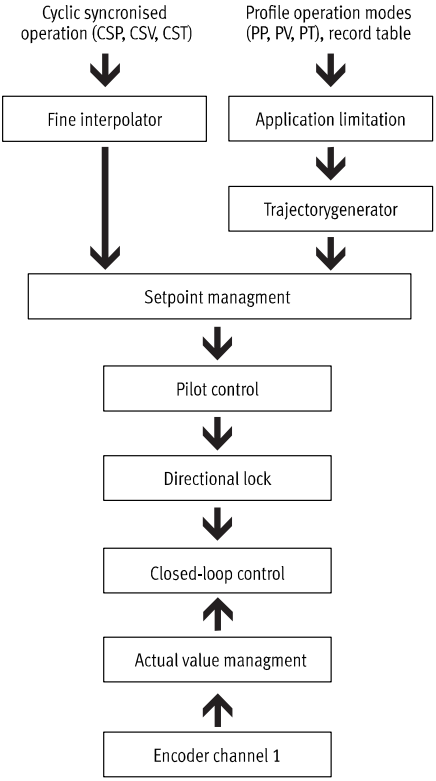


Fig. 14 Internal forwarding of the command values

9.2.1.2.1 Dynamic operating mode switch

The device can switch dynamically between some operating modes while the HEPP gripper is moving. In the case of other operating modes, the current motion command must be completed or cancelled before switching the operating mode. See the following table for an overview:

From...	**To...**							
	PP	PV	PT	CSP	CSV	CST	HM	PT-B
PP	–	a	a	c	c	c	c	c
PV	a	–	a	c	c	c	c	c
PT	a	a	–	c	c	c	c	c
CSP	d	d	d	–	e	e	d	d
CSV	d	d	d	e	–	e	d	d
CST	d	d	d	e	e	–	d	D
HM	MC	MC	MC	MC	MC	MC	–	MC
PT-B	d	d	d	d	d	d	d	–
P	a	a	a	d	d	d	d	d
V	a	a	a	d	d	d	d	d
T	a	a	a	d	d	d	d	d

Tab. 78 Operating mode switch – part 1

Meaning	
A	The dynamic switch between the operating modes is possible at any time.
b	Dynamic switching is possible. Unwanted command value jumps after switching the operating mode must be avoided by input corresponding command value specification by the user or by the higher-order PLC (reconciliation between setpoint and actual value).
c	One of the following conditions must be met for switching the operating mode: – The current motion command has been closed by a master controller. – The current motion command has been aborted by a stop. Once the request for a switch of operating mode has been accepted, no more motion commands are accepted until the operating mode switch is complete (message). Unwanted command value jumps after switching the operating mode must be avoided by input corresponding command value specification by the user or by the higher-order controller (reconciliation between setpoint and actual value).
d	The current motion command must be terminated by a stop before the new operating mode can be requested.
e	The dynamic switching of the operating mode is possible at any time if the required command values for the operating modes are mapped in the cyclic process data ➔ 9.2.1.2 Operating modes for performing motion commands.
MC	Motion complete
HM	Homing

Tab. 79 Operating mode switch – part 2

9.2.1.2.2 CiA402

If a dynamic switch between the CSP, CSV and CST operating modes is required, the following objects must be mapped in the cyclic process data:

– Modes of operation (0x6060)
– Mode of operation display (0x6061)
– The required setpoint and actual values of the operating modes

The following graph shows an example of the switch from the CSV operating mode to the CSP operating mode.

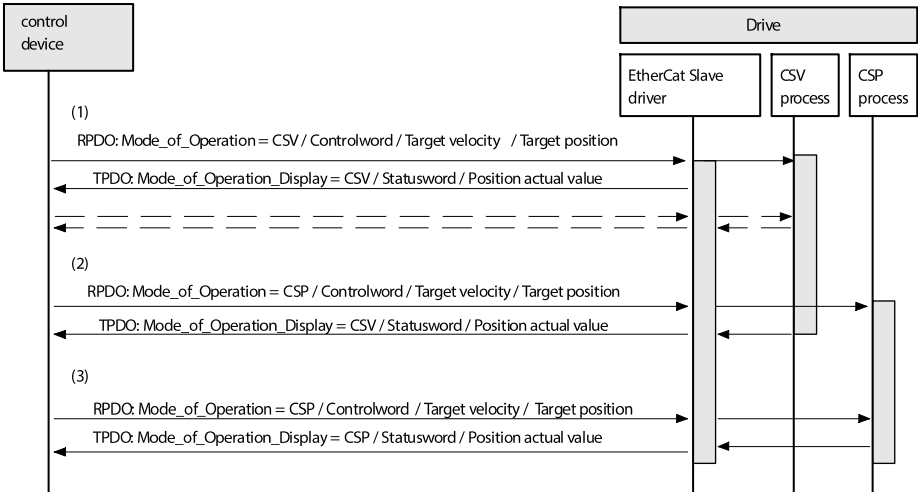


Fig. 15 Operating mode switch from CSV to CSP (example)

Explanations for the above graph:

1) The CSV operating mode is active. The nominal velocity (Target velocity) and the nominal position (Target position) are set. However, the target position is not used in the current operating mode.
2) Switch to the CSP operating mode.
3) The CSP operating mode is active. The nominal velocity (Target velocity) and the nominal position (Target position) are set. However, the target velocity is not used in the current operating mode.

9.2.1.3 Positioning mode (PP)

9.2.1.3.1 Function

In the positioning mode profile position operating mode, the theoretical path curve is calculated by the integrated trajectory generator (Profile position mode). The trajectory for the target position is calculated based on the motion quantities for the profile velocity, the acceleration, the deceleration and the jerk. If the value 0 is defined for the final velocity and no other task is triggered, the HEPP gripper remains position-controlled at the target position. The position, velocity and current regulators are active in positioning mode. The following types of position specification are supported in positioning mode:

Position specification	Description
Absolute	Absolute position referenced to the axis origin
relative to the current actual position	Distance referenced to the current position (actual position)
relative to the current setpoint position	Distance referenced to the last setpoint position
relative to the last target position	Distance referenced to the last target position

Tab. 80 Variations of positioning mode

Relative position specifications may result in an overflow of the internally mapped position. In the event of an overflow the parameterized reaction is executed. The reaction must be taken into account by a higher-order controller.

In positioning mode new tasks can be triggered at any time. The current task may be aborted, or the new task appended in a buffer. A jerk-free switch between the PP, PV and PT profile operating modes is possible.

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	•
1	TRV	Target window reaches velocity	•
2	TRT	Target window reaches torque	•
3	FEX	Following error position	•
4	FEV	Velocity following error	–
6	TMX	Position target area monitoring	•
7	TMV	Velocity target area monitoring	•
8	TMT	Torque target area monitoring	–
9...11	–	Reserved	–
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	–
20	STLN	Stroke limit reached negative	–
21	VM	Velocity monitoring	•
22	PB	Pushback monitoring	–
23	RDX	Remaining distance monitoring	•

Motion monitoring function status word			
24	MC	Trajectory completed	•
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	•
29	DEC	Drive decelerated	•
30... 31	–	Reserved	–

Tab. 81 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	Description
Target position	Target specification (specification of a route or absolute position)
Profile velocity	Setpoint value for velocity
Acceleration	Setpoint value for acceleration
Deceleration	Setpoint value for deceleration
Jerk	Maximum value for the jerk during the acceleration phase and deceleration phase
End velocity	Velocity at the target position

Tab. 82 Motion quantities

Triggering tasks

– The record table
– Fieldbus (direct mode)

Requirements

– Valid homing
– Controller enable

Timing

Example: positioning command with end velocity and unequal specifications for acceleration and deceleration

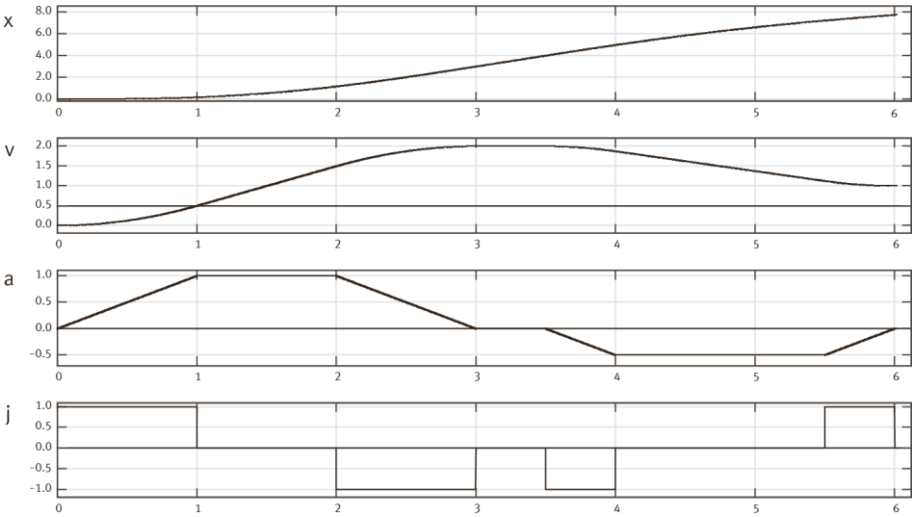


Fig. 16 Positioning mode timing graph (example)

Name	Description
x	Position
v	Velocity
a	Acceleration
j	Jerk

Tab. 83 Legend for positioning mode timing graph

9.2.1.3.2 CiA402

The following graphs show an overview of the objects involved in the positioning mode and their interaction with the trajectory generator:

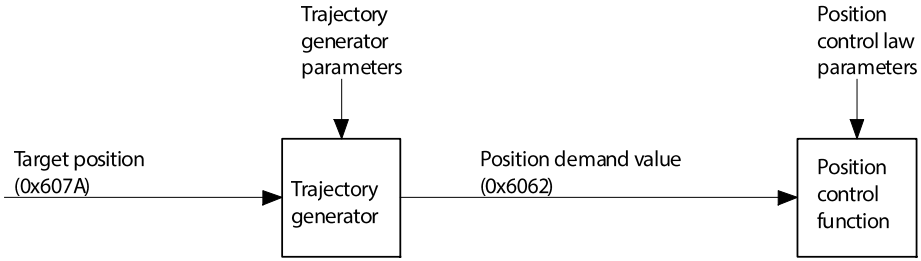


Fig. 17 Overview of the trajectory generator - position control operating mode (PP)

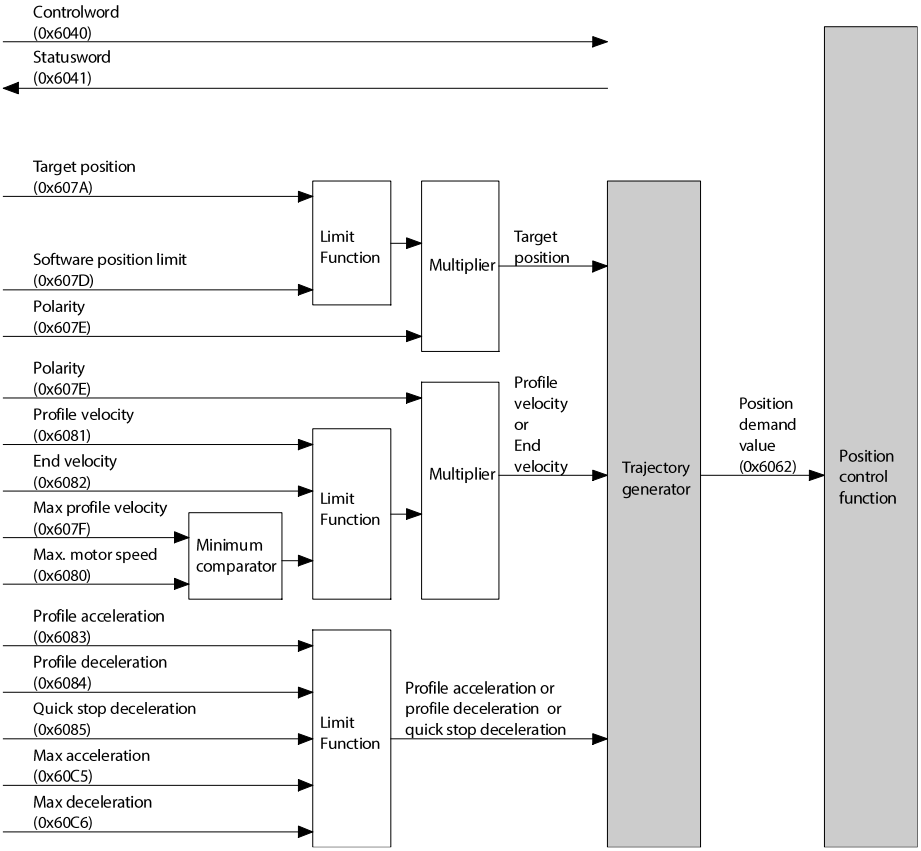


Fig. 18 Trajectory generator in positioning mode (PP)

Objects for positioning mode

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
90	0x6062.00	Setpoint value position	DINT
128	0x60E4.01	Actual position value	DINT
113104	0x6064.00	Actual value of modulo	DINT
1210	0x606C.00	Actual velocity value	DINT
8130	0x607A.00	Target position CiA402	DINT
4629	0x607D.01	Negative software limit position	DINT
4630	0x607D.02	Positive software limit position	DINT

Parameter	Index.Subindex	Name	Data type
1304	0x607F.00	Limit value velocity limit positive direction of movement	UDINT
8131	0x6081.00	Profile velocity CiA402	UDINT
8132	0x6082.00	End velocity CiA402	UDINT
8133	0x6083.00	Profile acceleration CiA402	UDINT
8134	0x6084.00	Profile deceleration CiA402	UDINT
8135	0x6085.00	Quick stop deceleration CiA402	UDINT
8136	0x60A4.00	Profile jerk CiA402	UDINT
1305	0x60C5.00	Upper limit value acceleration limitation	UDINT
1306	0x60C6.00	Upper limit value deceleration limitation	UDINT
88817	0x60F2.00	Positioning option code CiA402	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
90	0x2154.01	Setpoint value position	LINT
128	0x2155.09	Actual position value	LINT
113104	0x2197.05	Actual value of modulo	LINT
1210	0x2155.0B	Actual velocity value	REAL
151	0x2157.02	Actual torque value gear shaft	REAL
8130	0x216F.03	Target position CiA402	LINT
4629	0x2166.1E	Negative software limit position	LINT
4630	0x2166.1F	Positive software limit position	LINT
1304	0x2183.04	Limit value velocity limit positive direction of movement	REAL
8131	0x216F.04	Profile velocity CiA402	REAL
8132	0x216F.05	End velocity CiA402	REAL
8133	0x216F.06	Profile acceleration CiA402	REAL
8134	0x216F.07	Profile deceleration CiA402	REAL
8135	0x216F.08	Quick stop deceleration CiA402	REAL
8136	0x216F.09	Profile jerk CiA402	REAL
1305	0x2183.05	Upper limit value acceleration limitation	REAL
1306	0x2183.06	Upper limit value deceleration limitation	REAL
88817	0x216F.0C	Positioning option code CiA402	UINT

Tab. 84 Objects

Precondition for positioning mode

The following conditions must be fulfilled for positioning mode:

– Modes of operation display (0x6061) = 1
– Statusword (0x6041) = 1X0X X11X X011 0111b

Control and monitoring

Object 0x6040: Controlword

The object controls the following functions of positioning mode:

– Bit 4: start motion command (New setpoint)
– Bit 5: accept change immediately (Change set immediately)
– Bit 6: positioning type (absolute/relative)
– Bit 8: stop motion command (Halt)

Bit[1]				**Description**
8	6	5	4	
Positioning type				
0	0	x	x	absolute
0	1	x	X	relative; the reference point is defined in object 60F2h (Positioning option code).
Set new motion command				
0	X	0	0→1	If a motion command is currently running, the new motion command is saved. The new motion command is started on completion of the previous motion command.
Start motion command immediately				
0	X	1	0→1	The new motion command is started immediately.
Stop or continue motion command				
0	x	X	0	The motion command is run or continued with the acceleration ramp of the current motion command. Bit 4 must not be 0 but must not toggle. A rising edge in the stop status results in the motion command being aborted.
1	x	X	x	The motion command is interrupted with the stated deceleration ➔ object 0x6084, Profile deceleration.

1) signal status: 0 = low; 1 = high; 0→1 = rising edge

Tab. 85 Control positioning mode

Object 0x60F2, Positioning option code				
Bit 7	Bit 6	Bit 1	Bit 0	Description
Reference point for relative positioning				
x	x	0	0	New target position relative to the last target position (Target position) of the last motion command (relative to 0, if no last motion command is available).
x	x	0	1	New target position relative to the current setpoint position, output of path generator or current setpoint position of setpoint management.
x	x	1	0	New target position relative to the current actual position, current actual position of the actual value management.
x	x	1	1	reserved
Bit 7	Bit 6	Bit 1	Bit 0	Description

Tab. 86 Positioning option code

Object 0x6041: Statusword

The following statuses of positioning mode can be monitored with the object:

– Bit 10: target position reached (Target reached)
– Bit 12: motion command acknowledged (Setpoint acknowledge)
– Bit 13: position following error (Following error)

Bit[1)]			Description
13	12	10	
Target position reached (Target reached) (depending on bit 8 (Halt) in Controlword 0x6040)			
x	X	0	Halt = 0: target position has not yet been reached
x	X	1	Halt = 0: target position has been reached
x	X	0	Halt = 1: HEPP decelerated
x	X	1	Halt = 1: velocity = 0
Motion command acknowledged (setpoint acknowledge)			
x	0	x	Wait for new motion command
x	1	x	Motion command has been acknowledged
Position following error			
0	X	x	Position following error in tolerance range
1	X	x	Position following error limit reached

1) Signal status: 0 = low; 1 = high

Tab. 87 Monitoring positioning mode

9.2.1.3.3 PPROFIdrive

Control and monitoring

Application class ➔ Please refer to the CMMT-ST-SW manual 12.4.7.15, Finite State Machine Positioning Mode in Application Class 3 SATZANW ➔ Record Selection (SATZANW); AKTSATZ ➔ 12.4.7.16 Active Record (AKTSATZ)

Positioning mode PNUs

Parameter	PNU	Name	Data type
Px.	Profile-specific parameters		
1210	6.0	Actual velocity value	Integer16
113104	28.0	Actual value of modulo	Integer32
Px.	Manufacturer-specific parameters		
128	11067.0	Actual position value	Integer64
1210	11311.0	Actual velocity value	FloatingPoint
113104	12117.0	Actual value of modulo	Integer64
90	11045.0	Setpoint value position	Integer64
151	11070.0	Actual torque value gear shaft	FloatingPoint
4629	11584.0	Negative software limit position	Integer64
4630	11585.0	Positive software limit position	Integer64

Parameter	PNU	Name	Data type
1304	11334.0	Limit value velocity limit positive direction of movement	FloatingPoint
1305	11335.0	Upper limit value acceleration limitation	FloatingPoint
1306	11336.0	Upper limit value deceleration limitation	FloatingPoint

Tab. 88 PNUs

Move to fixed stop (application class 3)

Move to fixed stop performs a positioning with reference to a max. clamping torque. During move to a fixed stop, the fixed stop is approached from the current position before reaching the target position (e.g. at a workpiece). A torque is then created up to the desired clamping torque. For example, the following parameters can be set:

– Position
– Velocity
– Acceleration
– Deceleration
– Clamping torque
– Clamping torque offset

A running positioning order can be switched via "STW2.8 Traverse to fixed endstop". The switching runs a positioning order with clamping torque. The closed-loop limit manager limits the motion to the clamping torque. On completion of the order, the original limit is restored.

The following error monitor of the motion monitor is not active during the order and the following status bits are set:

– ZSW2.8 Move to fixed stop active
– POS_ZSW2.14 Move to fixed stop active

The following error monitor of the motion monitor is used during the order to detect the fixed stop.

If the fixed stop is detected, "POS_ZSW2.12 Fixed stop reached" is set and the stroke limit monitoring of the motion monitoring is activated on the basis of the current position.

When the clamping torque is applied, "POS_ZSW2.13 Fixed stop Clamping torque reached" is set. The clamping torque remains in place until a new movement command starts.

When the stroke limits for the fixed stop monitoring are reached, "POS_ZSW2.12 Fixed stop reached" is reset.

The following diagrams show the behavior:

Timing

Example 1: Move to fixed stop with reaching and stopping at the fixed stop

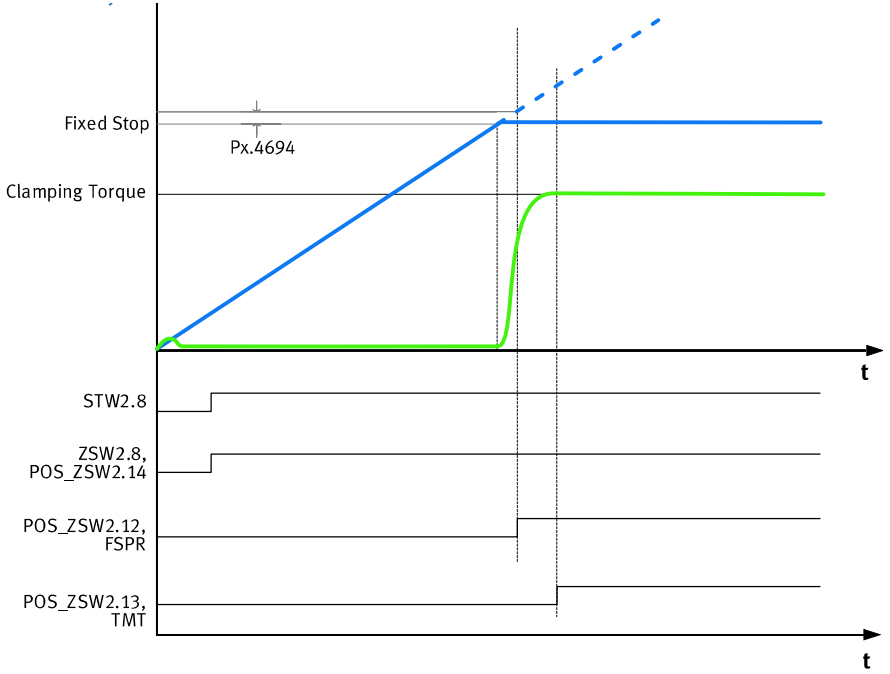


Fig. 19 Timing diagram move to fixed stop

Name	Description	ID Px.
Fixed Stop	Fixed stop	–
Clamping torque	Clamping torque	526801
FSPR	Motion monitoring function "Fixed stop reached" (1 = status reached)	460
TMT	Motion monitoring function "Target torque range monitor" (1 = status reached)	

Tab. 89 Legend for timing diagram move to fixed stop

Example 2: Move to fixed stop without reaching the fixed stop

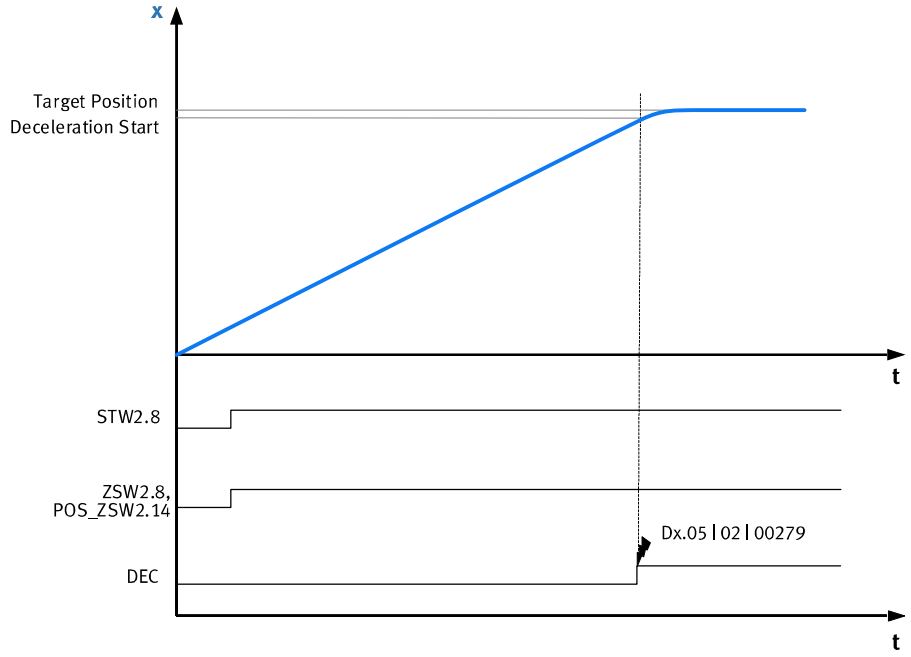


Fig. 20 Timing diagram fixed stop not reached

Name	Description	ID Px.
Target Position	Target position	–
Deceleration Start	Start of deceleration	
DEC	Motion monitoring function "Drive decelerated" (1 = status reached)	460
Dx.05|02| 000279	Diagnostic message Fixed stop not detected	–

Tab. 90 Legend for timing diagram fixed stop not reached

Example 3: Move to fixed stop with reaching and feedback at the fixed stop

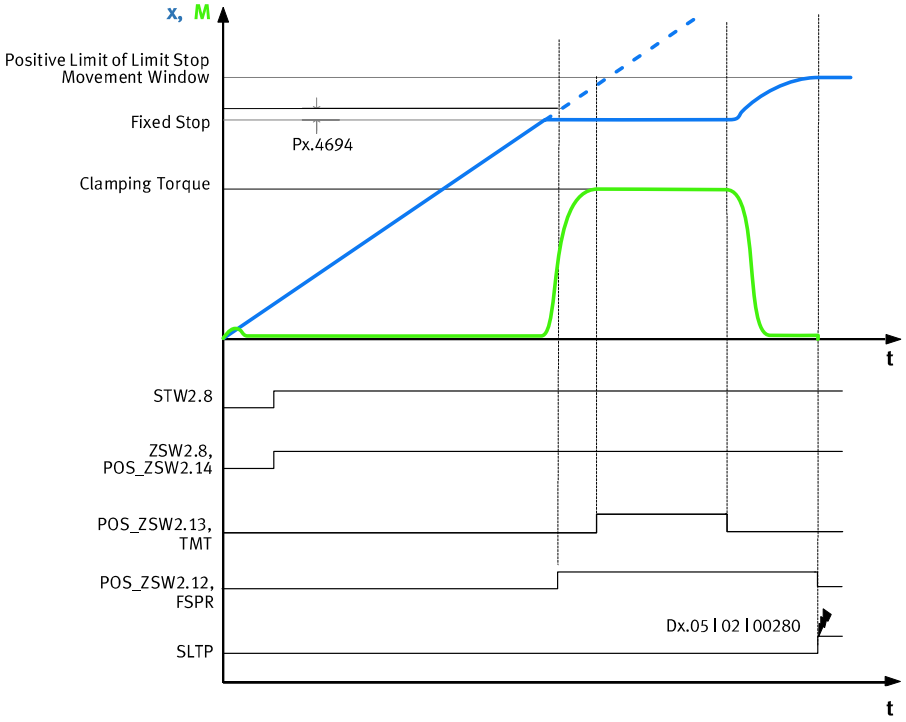


Fig. 21 Timing diagram fixed stop feeds back

Name	Description	ID Px.
Positive limit of limit stop movement window	Stroke limit positive for detection of a fixed stop	11280408
Fixed Stop	Fixed stop	–
Clamping torque	Clamping torque	526801
TMT	Motion monitoring function "Target torque range monitor" (1 = status reached)	460
FSPR	Motion monitoring function "Fixed stop reached" (1 = status reached)	
STLP	Motion monitoring function "Stroke limit reached" (1 = status reached)	
Dx.05|02|280	Diagnostic message Monitoring window of fixed stop left	–

Tab. 91 Legend for timing diagram fixed stop feeds back

Parameter

Details of the motion monitoring functions ➔ 9.3.1 Motion monitoring functions.

The fixed stop detection acts like the following error monitor for position with limit value and timing ➔ 9.3.3 Following error. The following error of the position and a cushioning time are used (Px.4694, Px.4693).

The detection of the pending clamping torque acts like the target range monitor for torque with limit value and timing ➔ 9.3.4 Target area monitoring.

The monitoring of the stroke limits after a detected fixed stop acts like the motion monitor for stroke limits ➔ 9.3.7 Stroke limit reached.

The window limits can be set in the positive and negative directions (Px.11280408, Px.11280409 ➔ Tab. 42 Parameter).

If the motion leaves the monitoring window in the positive and negative direction it is detected and triggers the following diagnostic message:

– Monitoring window of fixed stop left: Dx.05 | 02 | 00280

The following parameter determines the braking behavior upon exit of the monitoring window:

– Activation of automatic stop ramp stroke limit: Px.4675

The clamping torque depends on the direction of motion. The set clamping torque is added with the offset. This means that the resulting clamping torque depends on the sign of the offset.

An asymmetrical clamping torque can be set with the offset for suspended axes (parameter Clamping torque offset, Px.11280407).

ID Px.	Parameter	Description	
460	Movement monitoring status	Status of movement monitoring	
		Access	read/–
		Update	effective immediately
		Unit	–
4693	Fixed stop detection damping time	Determines the damping time for the fixed stop detection. If the absolute value of the following error for the specified time is above the limit value following error (Px.4694), the signal is set.	
		Access	read/write
		Update	effective immediately
		Unit	s
4694	Limit value following error	Specifies the limit value for the fixed stop detection. Is compared with the absolute value of the following error for fixed stop detection.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
11280409	Stroke limit negative for detection of a fixed stop	Specifies the negative stroke limit for detection of a fixed stop. The negative stroke limit must be lower than the positive stroke limit.	
		Access	read/write
		Update	effective immediately

ID Px.	Parameter	Description	
		Unit	user defined
11280408	Stroke limit positive for detection of a fixed stop	Specifies the positive stroke limit for detection of a fixed stop. The negative stroke limit must be lower than the positive stroke limit.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4675	Activation of automatic stop ramp stroke limit	Specifies whether automatic braking should be activated. If automatic braking is active, the HEPP is decelerated so that it stops before the stroke limit, if possible. If automatic braking is deactivated, the HEPP is only stopped once it reaches the stroke limit.	
		Access	read/write
		Update	effective immediately
		Unit	–
4665	Damping time target range	Specifies the damping time for target area monitoring (movement to a fixed stop). Minimum duration that the threshold value can be exceeded before a message is generated. The damping time is restarted if the actual value is below the threshold value or if the prefix for the specified setpoint value changes during the evaluation of the damping time.	
		Access	read/write
		Update	effective immediately
		Unit	s
4668	Monitoring window torque	Specifies the monitoring window for the target torque. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	Nm
526801	Clamping torque	Specifies the offset for the clamping torque for the approach to the fixed stop.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
11280407	Clamping torque off set	Specifies the offset for the clamping torque during approach to the fixed stop. The offset moves the clamping torque in order to retain an asymmetrical limit.	
		Access	read/write
		Update	effective immediately
		Unit	Nm

ID Px.	Parameter	Description	
11280606	Acceleration MDI	Displays the acceleration for the setpoint direct input MDI.	
		Access	read/write
		Update	effective immediately
		Unit	Inci/s²
11280607	Deceleration MDI	Displays the deceleration for the direct value setpoint MDI.	
		Access	read/write
		Update	effective immediately
		Unit	Inci/s²
11280604	Target position MDI	Displays the target position for the setpoint direct MDI.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
11280605	Profile velocity MDI	Displays the profile velocity for the direct value setpoint MDI.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

Tab. 92 Parameter

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		
11280606	36.0	Acceleration MDI	Integer16
11280607	37.0	Deceleration MDI	Integer16
11280604	34.0	Target position MDI	Integer32
11280605	35.0	Profile velocity MDI	Unsigned32
Px.	**Manufacturer-specific parameters**		
460	11144.0	Movement monitoring status	Unsigned32
4693	11635.0	Fixed stop detection damping time	FloatingPoint
4694	11636.0	Limit value following error	FloatingPoint
11280409	12331.0	Stroke limit negative for detection of a fixed stop	Integer64
11280408	12330.0	Stroke limit positive for detection of a fixed stop	Integer64
4675	11619.0	Activation of automatic stop ramp stroke limit	Boolean
4665	11611.0	Damping time target range	FloatingPoint
4668	11614.0	Monitoring window torque	FloatingPoint
526801	12168.0	Clamping torque	FloatingPoint
11280407	12329.0	Clamping torque offset	FloatingPoint
11280606	12341.0	Acceleration MDI	FloatingPoint

Parameter	PNU	Name	Data type
11280607	12342.0	Deceleration MDI	FloatingPoint
11280604	12339.0	Target position MDI	Integer64
11280605	12340.0	Profile velocity MDI	FloatingPoint

Tab. 93 PNUs

Diagnostic messages

ID Dx.	Name	Description
05 I 02 I 00279 (84017431)	Fixed stop not detected	Fixed stop was not detected
05 I 02 I 00280 (84017432)	Monitoring window of fixed stop left	Monitoring window of fixed stop left

Tab. 94 Diagnostic messages

9.2.1.4 Velocity mode (PV)

9.2.1.4.1 Function

In the velocity mode profile position operating mode, the theoretical velocity curve is calculated by the integrated trajectory generator (Profile velocity mode). The trajectory for the target velocity is calculated based on the motion quantities for the profile velocity, the acceleration, the deceleration and the jerk.
In velocity mode the velocity and current regulators are active.
The following types of velocity settings are supported in velocity mode:

Velocity specification	Description
... with stroke limitation	When the stroke limit is reached, the device reacts in accordance with parameterized STL monition monitoring ➔ 9.3.7 Stroke limit reached
... without stroke limitation	Velocity mode without path limitation

Tab. 95 Types of velocity mode

In velocity mode new commands can be triggered at any time. The current command may be aborted, or the new command appended in a buffer. A jerk-free switch between the PP, PV and PT profile operating modes is possible.

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	–
1	TRV	Target window reaches velocity	•
2	TRT	Target window reaches torque	–
Bit	Code	Name	Effective
3	FEX	Following error position	–

Motion monitoring function status word			
4	FEV	Velocity following error	•
6	TMX	Position target area monitoring	–
7	TMV	Speed target area monitoring	•
8	TMT	Torque target area monitoring	–
9...11	–	Reserved	–
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	•
20	STLN	Stroke limit reached negative	•
21	VM	Speed monitoring	•
22	PB	Pushback monitoring	–
23	RDX	Remaining distance monitoring	•
24	MC	Trajectory completed	•
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	•
29	DEC	Drive decelerated	•
30... 31	–	Reserved	–

Tab. 96 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	Description
Target velocity	Command value for the target velocity
Acceleration	Nominal acceleration
Deceleration	Nominal deceleration (with target velocity ‹ actual velocity)
Jerk	Maximum value for the jerk during the acceleration phase and deceleration phase
Activation of stroke limits	Stroke limit monitoring must be activated by parameters.
Negative stroke limit	If the negative stroke limit is greater than or equal to the positive stroke limit, the stroke limit is not effective.
Positive stroke limit	

Tab. 97 Motion quantities

Triggering commands

– The record table

– the fieldbus (direct mode)

Requirements

– Controller enable

Timing

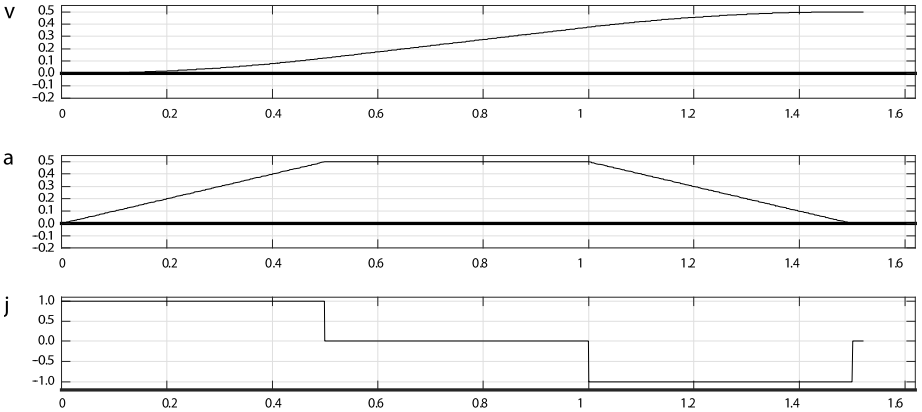


Fig. 22 Timing graph of velocity mode (example)

Name	Description
V	Velocity
A	Acceleration
J	Jerk

Tab. 98 Legend for timing graph of velocity mode

9.2.1.4.2 CiA 402

The following graphs show an overview of the objects involved in the velocity mode and their interaction with the trajectory generator:

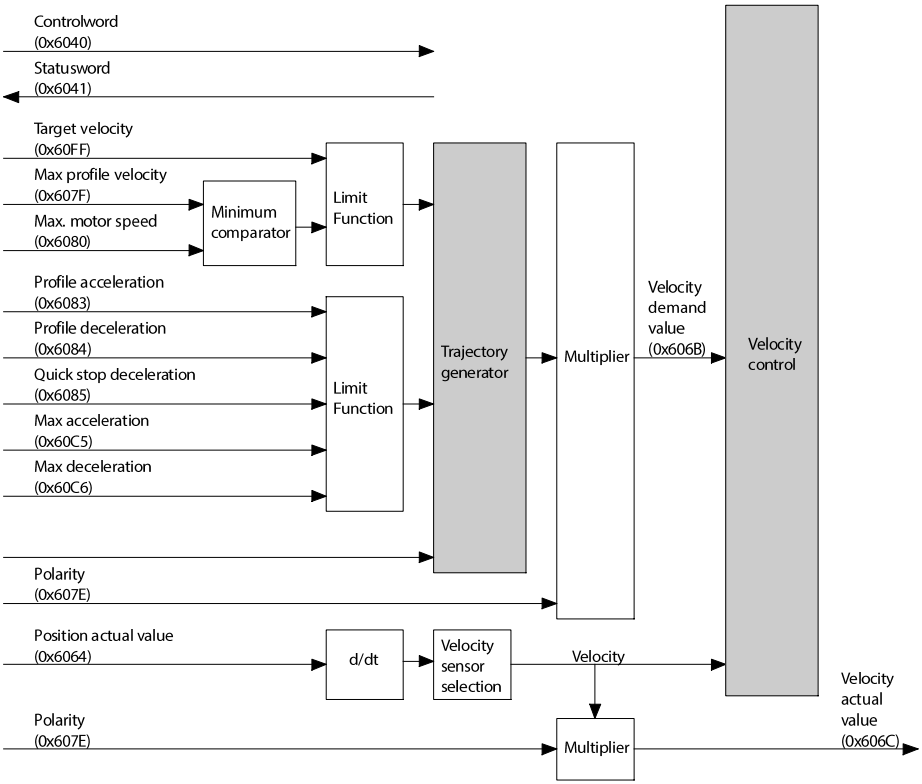


Fig. 23 Trajectory generator in velocity mode (PV)

Objects

Parameter	Index.Subind- ex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
128	0x60E4.01	Actual position value	DINT
113104	0x6064.00	Actual value of modulo	DINT
1210	0x606C.00	Actual velocity value	DINT
4610	0x606D.00	Monitoring window target velocity	UINT
468	0x6068.00	Damping time target reached	UINT
466	0x606F.00	Monitoring window velocity standstill monitor- ing	UINT
465	0x6070.00	Standstill damping time	UINT
1304	0x607F.00	Limit value velocity limit positive direction of	UDINT

Parameter	Index.Subind- ex	Name	Data type
		movement	
8133	0x6083.00	Profile acceleration CiA402	UDINT
8134	0x6084.00	Profile deceleration CiA402	UDINT
8135	0x6085.00	Quick stop deceleration CiA402	UDINT
1305	0x60C5.00	Upper limit value acceleration limitation	UDINT
1306	0x60C6.00	Upper limit value deceleration limitation	UDINT
464	0x60F8.00	Monitoring window velocity: following error	DINT
8137	0x60FF.00	Target velocity CiA402	DINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
128	0x2155.09	Actual position value	LINT
113104	0x2197.05	Actual value of modulo	LINT
1210	0x2155.0B	Actual velocity value	REAL
4610	0x2166.0B	Monitoring window target velocity	REAL
468	0x2166.09	Damping time target reached	REAL
466	0x2166.07	Monitoring window velocity standstill monitoring	REAL
465	0x2166.06	Standstill damping time	REAL
1304	0x2183.04	Limit value velocity limit positive direction of movement	REAL
8133	0x216F.06	Profile acceleration CiA402	REAL
8134	0x216F.07	Profile deceleration CiA402	REAL
8135	0x216F.08	Quick stop deceleration CiA402	REAL
1305	0x2183.05	Upper limit value acceleration limitation	REAL
1306	0x2183.06	Upper limit value deceleration limitation	REAL
464	0x2166.05	Monitoring window velocity: following error	REAL
8137	0x216F.0A	Target velocity CiA402	REAL

Tab. 99 Objects

Precondition for velocity mode

The following conditions must be fulfilled for velocity mode:

– Modes of operation display (0x6061) = 3
– Statusword (0x6061) = XX0X XX1X X011 0111b

Control and monitoring

In velocity mode, start signal or starting edge is not required to start the motion.

Object 0x6040: Controlword

The object controls the following velocity mode functions:

– Bit 8: stop motion command (Halt)

Bit[1)]	Description
8	
Stop/continue movement (Halt)	
0	The motion is executed or continued
1	The motion is stopped with the stated deceleration (see object 0x6084, Profile deceleration)

1) Signal status: 0 = low; 1 = high

Tab. 100 Control velocity mode

Object 0x6041: Statusword

The following statuses of velocity mode can be monitored with the object:

– Bit 10: target velocity reached (Target reached)
– Bit 12: velocity (Speed)
– Bit 13: velocity following error (Following error)

Bit[1)]			Description
13	12	10	
Target velocity reached (Target reached) (depending on bit 8 (Halt) in Controlword 0x6040)			
x	X	0	Halt = 0: target velocity was not reached
x	X	1	Halt = 0: target velocity was reached
x	X	0	Halt = 1: HEPP decelerated
x	X	1	Halt = 1: velocity = 0
Standstill message			
x	0	x	Velocity ≠ 0
x	1	x	Velocity = 0
Velocity following error (Following error)			
0	X	x	A velocity following error is not active
1	X	x	Velocity following error limit reached

1) signal status: 0 = low; 1 = high; x = any

Tab. 101 Monitoring velocity mode

9.2.1.4.3 PROFIdrive

Control and monitoring

Application class ➔ Please refer to the CMMT-ST-SW manual 12.4.3.2 Finite State Machine Velocity Mode in Application Class 1

PNUs

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		

Parameter	PNU	Name	Data type
1210	6.0	Actual velocity value	Integer16
113104	28.0	Actual value of modulo	Integer32
Px.	**Manufacturer-specific parameters**		
128	11067.0	Actual position value	Integer64
113104	12117.0	Actual value of modulo	Integer64
1210	11311.0	Actual velocity value	FloatingPoint
4610	11565.0	Monitoring window target velocity	FloatingPoint
468	11152.0	Damping time target reached	FloatingPoint
466	11150.0	Monitoring window velocity standstill monitoring	FloatingPoint
465	11149.0	Standstill damping time	FloatingPoint
1304	11334.0	Limit value velocity limit positive direction of movement	FloatingPoint
1305	11335.0	Upper limit value acceleration limitation	FloatingPoint
1306	11336.0	Upper limit value deceleration limitation	FloatingPoint
464	11148.0	Monitoring window velocity: following error	FloatingPoint

Tab. 102 PNUs

9.2.1.5 Force/torque mode (PT) with or without holding brake

9.2.1.5.1 Function

In the force/torque mode profile position operating mode the theoretical setpoint curve is calculated by the integrated trajectory generator (Profile torque mode). The trajectory for the target torque is calculated based on the torque rise time. The force/torque mode enables force control. In force/torque mode the velocity and current regulators are active.
The transition to the new setpoint quantity can be influenced by parameterization of the rise time. The following variants are supported in force/torque mode:

Force/torque mode ...	Description
With velocity and without stroke limitation	Force/torque with velocity limitation
With velocity and stroke limitation	Force/torque with velocity and stroke limitation

Tab. 103 Variants of force/torque

In force/torque mode new commands can be triggered at any time. The current command may be aborted, or the new command appended in a buffer. A jerk-free switch between the PP, PV and PT profile operating modes is possible.

Force/torque mode with brake (PT/B)

Force/torque mode with brake is a variant of force/torque mode in which a command for force/torque control is executed with set brake.

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	–
1	TRV	Target window reaches velocity	–
2	TRT	Target window reaches torque	•
3	FEX	Following error position	–
4	FEV	Velocity following error	–
6	TMX	Position target area monitoring	–
7	TMV	Speed target area monitoring	–
8	TMT	Torque target area monitoring	•
9...11	–	Reserved	–
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	•
20	STLN	Stroke limit reached negative	•
21	VM	Speed monitoring	•
22	PB	Pushback monitoring	•
23	RDX	Remaining distance monitoring	•
24	MC	Trajectory completed	•
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	–
29	DEC	Drive decelerated	–
30... 31	–	Reserved	–

Tab. 104 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	**Description**
Target torque	Target specification
Torque rise time	Minimum time for reaching the target torque
Speed limit value	Maximum velocity for reaching the target torque
Activation of stroke limits	Stroke limit monitoring must be activated by parameters.

Motion quantities	Description
Negative stroke limit	If the negative stroke limit is greater than or equal to the positive stroke limit, the stroke limit is not effective.
Positive stroke limit	

Tab. 105 Motion quantities

Triggering commands

– the fieldbus (direct mode)

Requirements for force/torque

– Controller enable

Timing

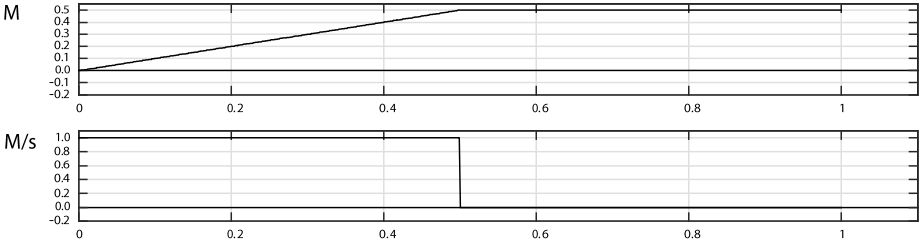


Fig. 24 Force/torque mode timing graph (example)

Name	Description
M	Torque
M/s	Torque increase

Tab. 106 Legend for force/torque mode timing graph

9.2.1.5.2 CiA 402

The following graph shows an overview of the objects involved in the force/torque mode and their interaction with the trajectory generator:

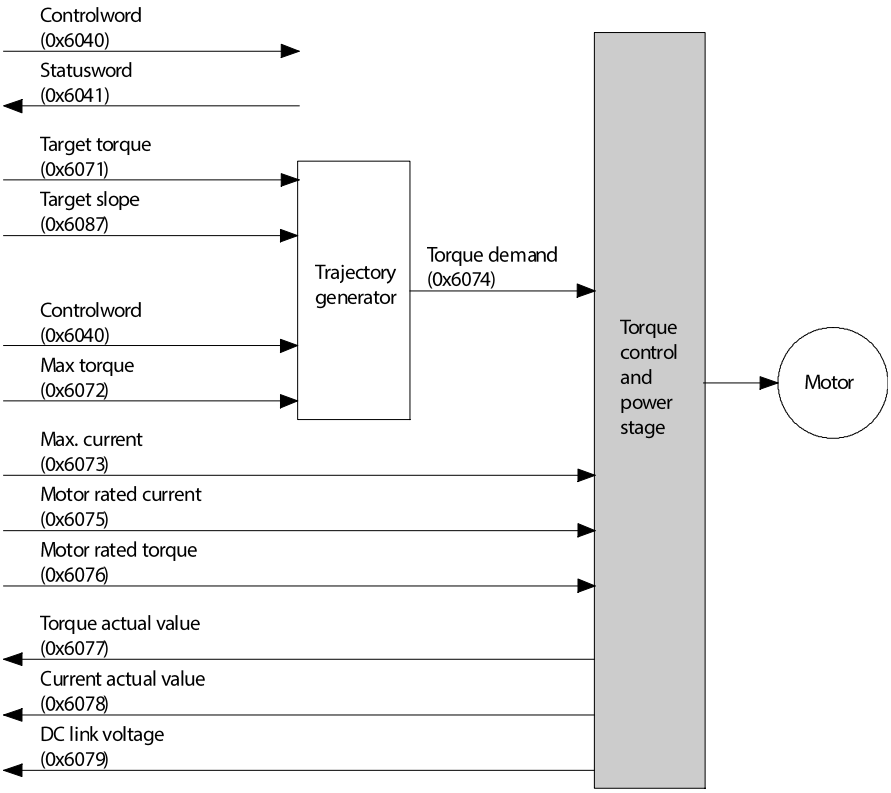


Fig. 25 Trajectory generator in force/torque (PT)

Objects

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
526795	0x6071.00	Target torque CiA402	INT
526796	0x6072.00	Maximum torque symmetrical	UINT
856	0x6073.00	Limit value total current (closed loop controller)	UINT
3014	0x6074.00	Setpoint generator output torque	INT
7118	0x6075.00	Current nominal current	UDINT
7139	0x6076.00	Resulting nominal torque	UDINT
151	0x6077.00	Actual torque value gear shaft	INT
814	0x6078.00	Actual active current value	INT
480	0x6079.00	Actual value DC link voltage	UDINT

Parameter	Index.Subindex	Name	Data type
526799	0x6087.00	Torque slope CiA402	UDINT
853	0x60E0.00	Upper limit value torque (closed loop controller)	UINT
852	0x60E1.00	Lower limit value torque (closed loop controller)	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
526795	0x216F.0D	Target torque CiA402	REAL
526796	0x2168.17	Maximum torque symmetrical	REAL
856	0x2168.07	Limit value total current (closed loop controller)	REAL
3014	0x2188.07	Setpoint generator output torque	REAL
7118	0x2162.05	Current nominal current	REAL
7139	0x2162.0C	Resulting nominal torque	REAL
151	0x2157.02	Actual torque value gear shaft	REAL
814	0x2153.0F	Actual active current value	REAL
480	0x2114.01	Actual value DC link voltage	REAL
526799	0x216F.0E	Torque slope CiA402	REAL
853	0x2168.04	Upper limit value torque (closed loop controller)	REAL
852	0x2168.03	Lower limit value torque (closed loop controller)	REAL

Tab. 107 Objects

Precondition for force/torque mode

The following conditions must be fulfilled for force/torque mode:

– Modes of operation display (0x6061) = 4
– Statusword (0x6061) = XX0X XX1X X011 0111b

Control and monitoing

Object 0x6040: Controlword

In force/torque mode, start signal or starting slope is not required to start movement.

The object controls the following force/torque mode functions:

– Bit 8: stopping, executing or continuing movement (Halt)

Bit[1)]	Description
8	
Stop/continue movement (Halt)	
0	The motion is executed or continued.
1	The motion is stopped with the stated torque ramp (see object 0x6087, Torque slope)

1) Signal status: 0 = low; 1 = high

Tab. 108 Controlling force/torque mode

Object 0x6041: Statusword

The following statuses of force/torque mode can be monitored with the object:

– Bit 10: target reached (Target reached)

Bit[1)] 10	Description
Target reached (Target reached) (depending on Bit 8 (Halt) in Controlword 0x6040)	
0	Halt = 0: force/torque has not yet been reached.
1	Halt = 0: force/torque has been reached.
0	Halt = 1: HEPP decelerated
1	Halt = 1: velocity = 0

1) Signal status: 0 = low; 1 = high

Tab. 109 Monitoring force/torque mode

9.2.1.5.3 PROFIdrive

PNUs

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
526796	12166.0	Maximum torque symmetrical	FloatingPoint
856	11218.0	Limit value total current (closed loop controller)	FloatingPoint
3014	11502.0	Setpoint generator output torque	FloatingPoint
7118	11691.0	Current nominal current	FloatingPoint
7139	11704.0	Resulting nominal torque	FloatingPoint
151	11070.0	Actual torque value gear shaft	FloatingPoint
814	11190.0	Actual active current value	FloatingPoint
480	2148.0	Actual value DC link voltage	FloatingPoint
853	11215.0	Upper limit value torque (closed loop controller)	FloatingPoint
852	11214.0	Lower limit value torque (closed loop control ler)	FloatingPoint

Tab. 110 PNUs

9.2.1.6 Cyclic synchronized positioning mode (CSP)

9.2.1.6.1 Function

Cyclic synchronized positioning mode enables setpoint values to be preset for the device in a fixed time grid using the HEPP profile (SYNC interval). The import of the setpoint values is synchronized with the synchronization signal of the higher-order controller. The synchronization signal is generally slower by a whole number than the cycle of the closed-loop controller. The synchronization time is generally set by the higher-order PLC (synchronization time 1 ... 20 ms, increment 1 ms, ➔ Px.1051). The integrated fine interpolator therefore calculates intermediate support points and derivations from the setpoint value for the closed-loop controller (interpolation).

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	–
1	TRV	Target window reaches velocity	–
2	TRT	Target window reaches torque	–
3	FEX	Following error position	•
4	FEV	Velocity following error	–
6	TMX	Position target area monitoring	–
7	TMV	Velocity target area monitoring	–
8	TMT	Torque target area monitoring	–
9...11	–	reserved	–
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	–
20	STLN	Stroke limit reached negative	–
21	VM	Speed monitoring	•
22	PB	Pushback monitoring	–
23	RDX	Remaining distance monitoring	–
24	MC	Trajectory completed	–
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	–
29	DEC	Drive decelerated	–
30... 31	–	reserved	–

Tab. 111 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	Description
Setpoint position	The higher-order PLC supplies the setpoint position.
Velocity (optional)	External pilot control values for the velocity and the torque can also be specified (optional).
Torque (optional)	

Tab. 112 Motion quantities

Requirements

– Controller enable

Pilot control values

External pilot control values for the velocity and the torque can also be specified (optional).
The integrated interpolator distinguishes the following operating modes in CSP operation, which can be selected with the parameter Px.11412:

Operating modes of the interpolator in CSP operation (ID Px.11412)	
Operating modes	Description
CSP	Straight CSP operation without external pilot control values; pilot control values are generated by an internal algorithm – Ipo algorithms 4th order
CSP-V	External velocity pilot control value – Ipo algorithms 3rd order
CSP-T	external torque pilot control value – Ipo algorithms 3rd order
CSP-VT	external velocity and torque pilot control values – Ipo algorithms 2nd order

Tab. 113 Operating Modes of the Integrated Interpolator in CSP Operation

The interpolator has two sets of interpolator algorithm instances and can be switched between the CSP, CSV and CST operating modes. When switching, the required algorithm instances are first generated and populated with input data. When the algorithms reach the initialized status, the regulation is switched to the new operating mode.
The following graph shows an example of the input and output values for the interpolator in straight CSP operation without external pilot control values.

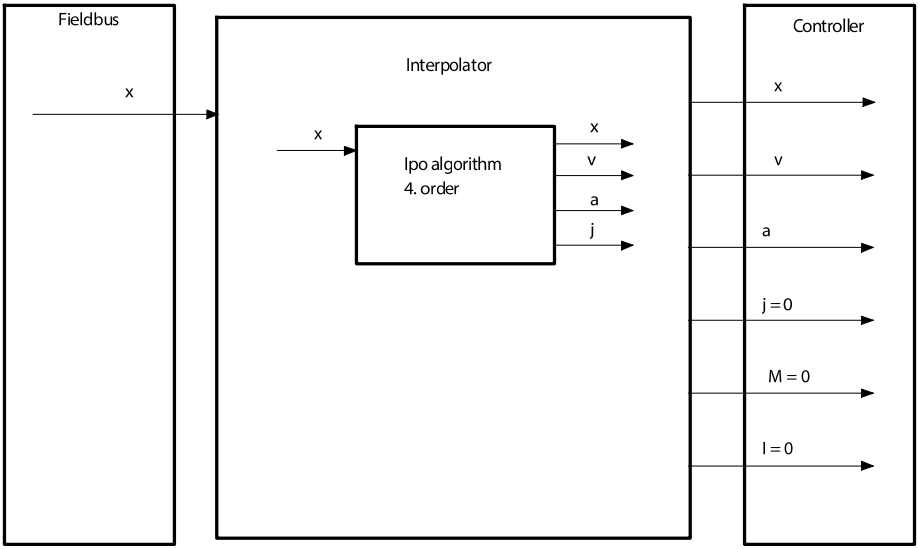


Fig. 26 CSP operation without external pilot control

The following graph shows an example of the input and output values for the interpolator in straight CSP operation with velocity and torque pilot control values.

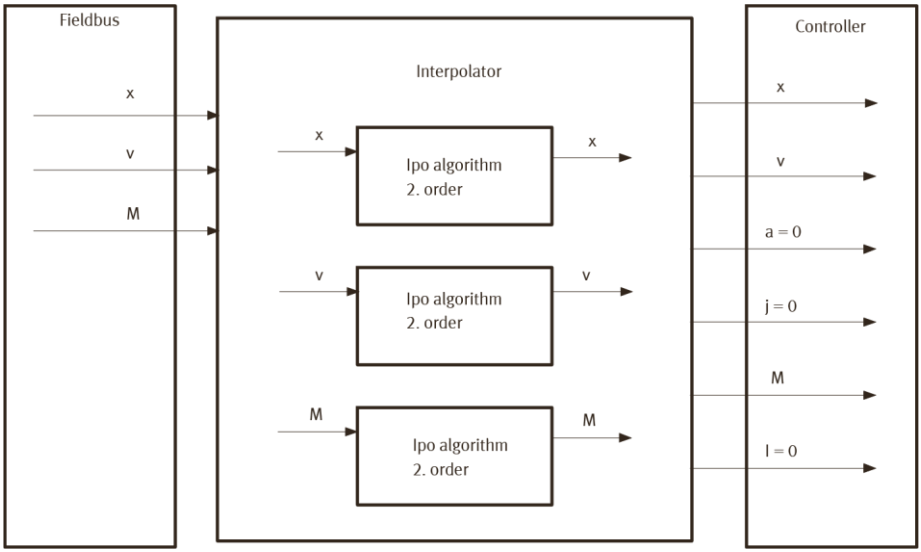


Fig. 27 CSP operation with external velocity and torque pilot control (CSP-VT)

Parameters and diagnostic messages

ID Px.	Parameter	Description	
11412	Interpolation mode CSP	Selection of CSx mode for the position default. The setting is accepted when the interpolation mode is activated by the device profile.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 114 Parameter

Diagnostic messages

ID Dx.	Name	Description
08 I 12 I 00250 (135004410)	Invalid mode of operation	An invalid mode of operation was requested

Tab. 115 Diagnostic messages

9.2.1.6.2 CiA 402

The following graphs show an overview of the objects involved in the cyclic synchronized positioning mode and their interaction with the closed-loop controller.

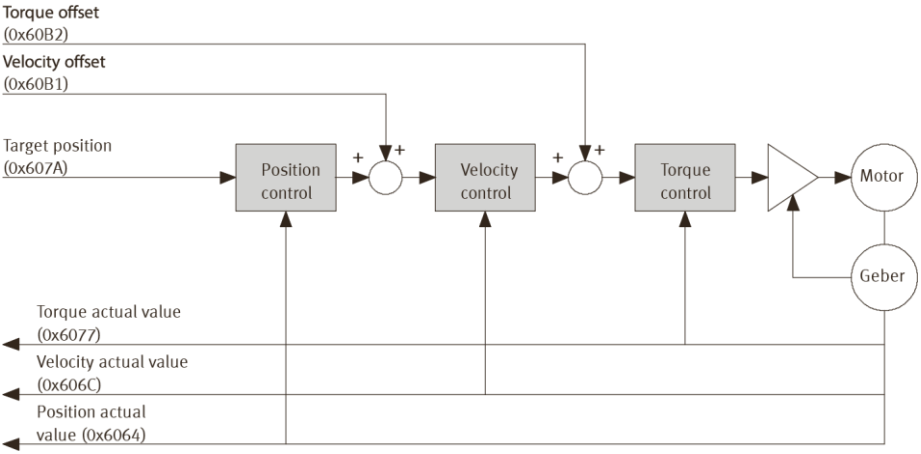


Fig. 28 Overview of the cyclic synchronized positioning mode (CSP)

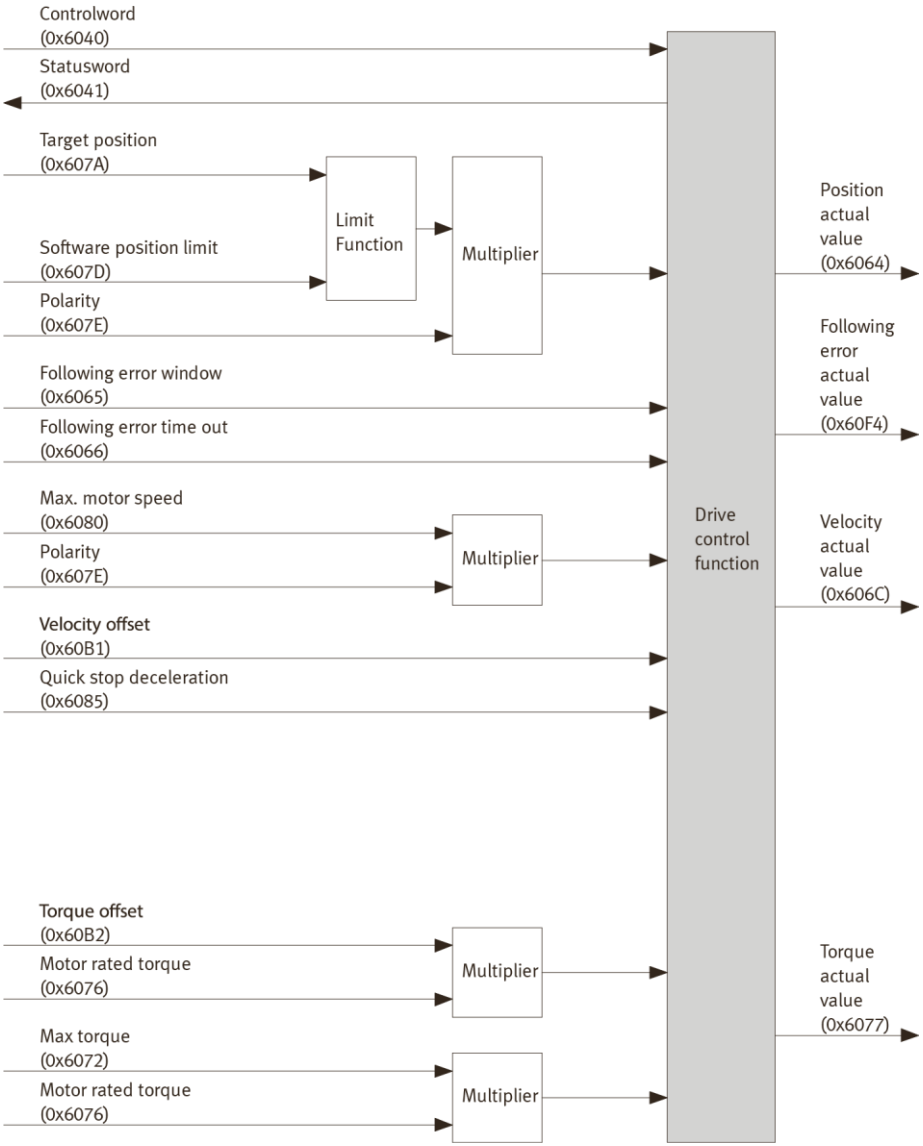


Fig. 29 Object overview of the cyclic synchronized positioning mode (CSP)

The position following error is only evaluated in the "operation enabled" status.

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
128	0x60E4.01	Actual position value	DINT
113104	0x6064.00	Actual value of modulo	DINT
463	0x6065.00	Monitoring window position: following error	UDINT
462	0x6066.00	Damping time position: following error	UINT
1210	0x606C.00	Actual velocity value	DINT
526796	0x6072.00	Maximum torque symmetrical	UINT
7139	0x6076.00	Resulting nominal torque	UDINT
151	0x6077.00	Actual torque value gear shaft	INT
8130	0x607A.00	Target position CiA402	DINT
4629	0x607D.01	Negative software limit position	DINT
4630	0x607D.02	Positive software limit position	DINT
8135	0x6085.00	Quick stop deceleration CiA402	UDINT
8138	0x60B1.00	Velocity offset CiA402	DINT
8111	0x60B2.00	Torque offset CiA402	INT
4682	0x60F4.00	Current position: following error	DINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
128	0x2155.09	Actual position value	LINT
113104	0x2197.05	Actual value of modulo	LINT
463	0x2166.04	Monitoring window position: following error	REAL
462	0x2166.03	Damping time position: following error	REAL
1210	0x2155.0B	Actual velocity value	REAL
526796	0x2168.17	Maximum torque symmetrical	REAL
7139	0x2162.0C	Resulting nominal torque	REAL
151	0x2157.02	Actual torque value gear shaft	REAL
8130	0x216F.03	Target position CiA402	LINT
4629	0x2166.1E	Negative software limit position	LINT
4630	0x2166.1F	Positive software limit position	LINT
8135	0x216F.08	Quick stop deceleration CiA402	REAL
8138	0x216F.0B	Velocity offset CiA402	REAL
8111	0x216F.01	Torque offset CiA402	REAL
4682	0x2166.42	Current position: following error	REAL

Parameter	Index.Subindex	Name	Data type
11412	0x217B.0D	Interpolation mode CSP	UDINT

Tab. 116 Objects

Objects in the different CSP operating modes

The objects marked with a dot are effective in the different CSP operating modes.

CSP	CSP-V	CSP-T	CSP-VT	Objects
•	•	•	•	0x607A
–	•	–	•	0x60B1
–	–	•	•	0x60B2

Tab. 117 Effective objects

Precondition for the cyclic synchronized positioning mode

The following conditions must be fulfilled for the cyclic synchronized positioning mode:

– Modes of operation display (0x6061) = 8
– Statusword (0x6061) = XX0X XX1X X011 0111b

Control and monitoring

Object 0x6040: Controlword

Bits specific to operating modes are neither required or evaluated. The operating mode is active immediately.

The bit Halt in the control word is ignored.

Object 0x6041: Statusword

The following statuses of cyclic synchronized positioning mode can be monitored with the object:

– Bit 12: HEPP follows the setpoint value (HEPP follows the command value)
– Bit 13: position following error (Following error)

Bit[1)]		Description
13	12	
HEPP follows the setpoint value (HEPP follows the command value)		
x	0	The HEPP gripper does not follow the setpoint value for internal reasons (e.g. because a safety function is active)
x	1	The HEPP gripper in operation enabled status and follows the setpoint value.
Position following error (Following error)		
0	1	Position following error in tolerance range
1	1	Position following error limit reached

1) Signal status: 0 = low; 1 = high

Tab. 118 Monitoring cyclic synchronized positioning mode

9.2.1.6.3 PROFIdrive

PNUs

Parameter	PNU	Name	Data type
Px.	Profile-specific parameters		

Parameter	PNU	Name	Data type
1210	6.0	Actual velocity value	Integer16
113104	28.0	Actual value of modulo	Integer32
Px.	**Manufacturer-specific parameters**		
128	11067.0	Actual position value	Integer64
113104	12117.0	Actual value of modulo	Integer64
463	11147.0	Monitoring window position: following error	FloatingPoint
462	11146.0	Damping time position: following error	FloatingPoint
1210	11311.0	Actual velocity value	FloatingPoint
526796	12166.0	Maximum torque symmetrical	FloatingPoint
7139	11704.0	Resulting nominal torque	FloatingPoint
151	11070.0	Actual torque value gear shaft	FloatingPoint
4629	11584.0	Negative software limit position	Integer64
4630	11585.0	Positive software limit position	Integer64
4682	11624.0	Current position: following error	FloatingPoint

Tab. 119 PNUs

9.2.1.7 Cyclic synchronized velocity mode (CSV)

9.2.1.7.1 Function

The cyclic synchronized velocity mode enables setpoint values to be preset for the device in a fixed time grid using the HEPP profile (SYNC interval). The import of the setpoint values is synchronized with the synchronization signal of the higher-order controller. The synchronization signal is generally slower by a whole number than the cycle of the closed-loop controller. The synchronization time is generally set by the higher-order PLC (synchronization time 1 ... 20 ms, increment 1 ms, ➔ Px.1051). The integrated fine interpolator therefore calculates intermediate support points and derivations from the setpoint value for the closed-loop controller (interpolation).

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	–
1	TRV	Target window reaches velocity	–
2	TRT	Target window reaches torque	–
3	FEX	Following error position	–
4	FEV	Velocity following error	•
6	TMX	Position target area monitoring	–
7	TMV	Velocity target area monitoring	–
8	TMT	Torque target area monitoring	–
9...11	–	reserved	–

Motion monitoring function status word			
Bit	Code	Name	Effective
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	–
20	STLN	Stroke limit reached negative	–
21	VM	Speed monitoring	•
22	PB	Pushback monitoring	–
23	RDX	Remaining distance monitoring	–
Bit	Code	Name	Effective
24	MC	Trajectory completed	–
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	–
29	DEC	Drive decelerated	–
30... 31	–	reserved	–

Tab. 120 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	Description
Nominal velocity	The higher-order PLC supplies the setpoint velocity.
Torque	Pilot control values for the torque can also be specified (optional).

Tab. 121 Motion quantities

Requirements

– Controller enable

Pilot control values

External pilot control values for the torque can also be specified (optional).
The integrated interpolator distinguishes the following operating modes in CSV operation, which can be selected with the parameter Px.11413:

Operating modes of the interpolator in CSV operation (ID Px.11413)	
Operating modes	Description
CSV	Straight CSV operation without external pilot control values; pilot control values are generated by an internal algorithm. – Ipo algorithms 4th order

Operating modes of the interpolator in CSV operation (ID Px.11413)	
Operating modes	Description
CSV-T	external torque pilot control value – Ipo algorithms 3rd order

Tab. 122 Operating modes of the integrated interpolator in CSV operation

The interpolator has two sets of interpolator algorithm instances and can be switched between the CSP, CSV and CST operating modes. When switching, the required algorithm instances are first generated and populated with input data. When the algorithms reach the initialized status, the regulation is switched to the new operating mode.
The following graphs show the input and output values for the interpolator in the CSV operating modes.

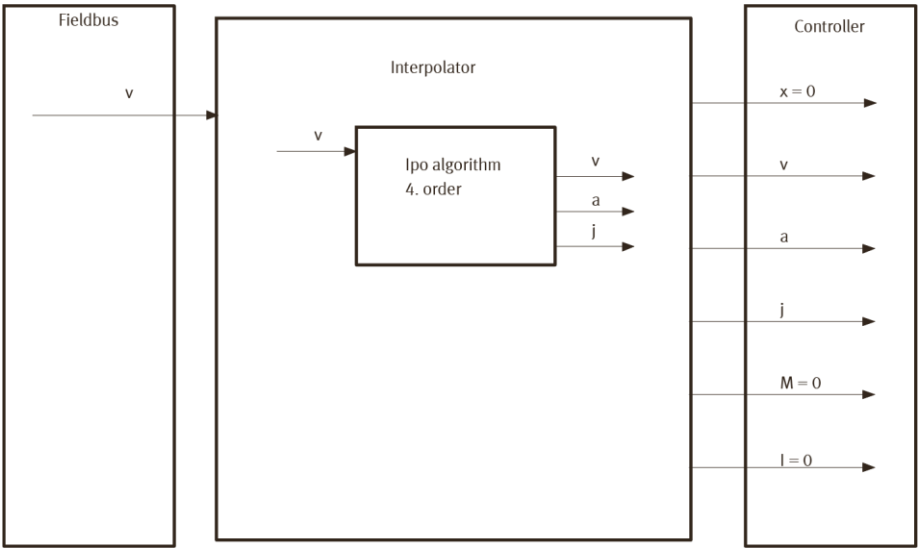


Fig. 30 CSV operation without external pilot control

The following graph shows an example of the input and output values for the interpolator in straight CSV operation with velocity and torque pilot control values.

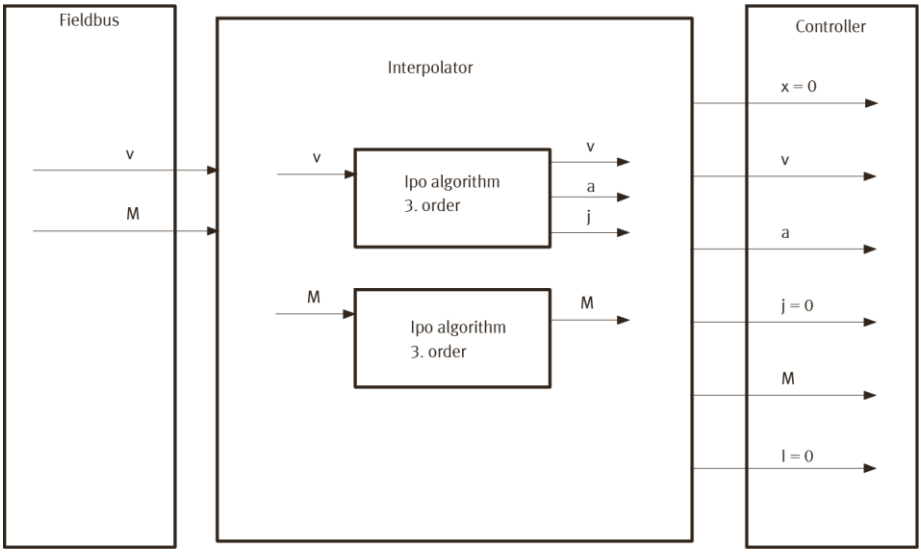


Fig. 31 CSV operation with external torque pilot control (CSV-T)

Parameter

ID Px.	Parameter	Description	
11413	Interpolation mode CSV	Selection of CSx mode for the velocity default. The setting is accepted when the interpolation mode is activated by the device profile.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 123 Parameter

Diagnostic messages

ID Dx.	Name	Description
08 I 12 I 00250 (135004410)	Invalid mode of operation	An invalid mode of operation was requested

Tab. 124 Diagnostic messages

9.2.1.7.2 CiA 402

The following graphs show an overview of the objects involved in the cyclic synchronized velocity mode and their interaction with the closed-loop controller.

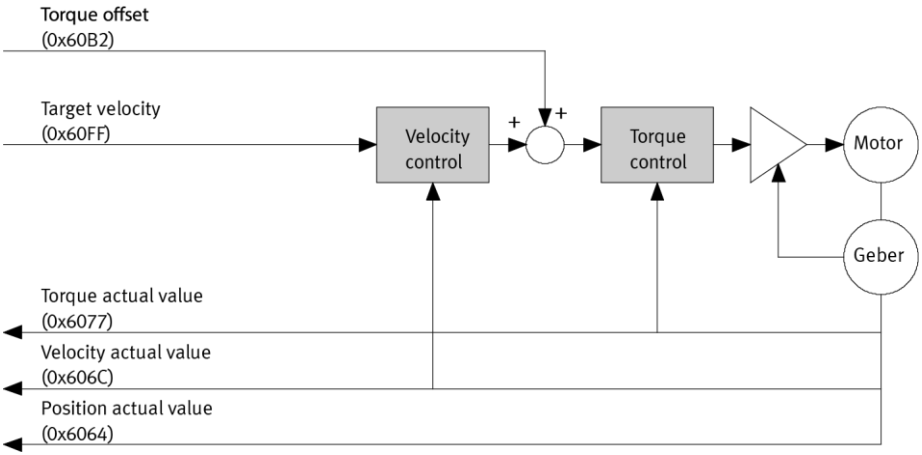


Fig. 32 Overview of the cyclic synchronized velocity mode (CSV)

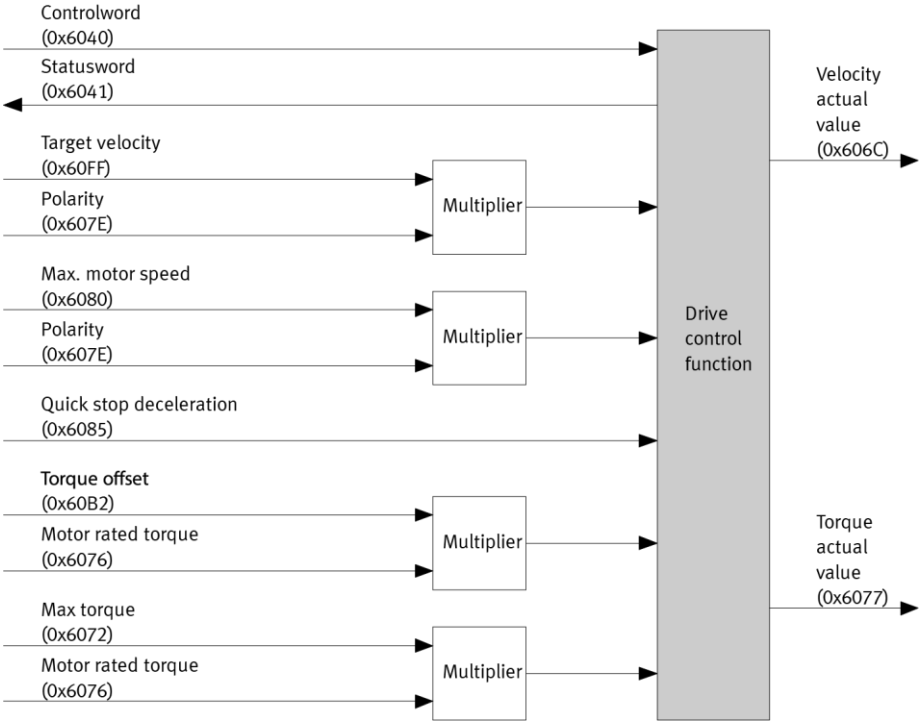


Fig. 33 Object overview of the cyclic synchronized velocity mode (CSV)

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
128	0x60E4.01	Actual position value	DINT
113104	0x6064.00	Actual value of modulo	DINT
1210	0x606C.00	Actual velocity value	DINT
526796	0x6072.00	Maximum torque symmetrical	UINT
7139	0x6076.00	Resulting nominal torque	UDINT
151	0x6077.00	Actual torque value gear shaft	INT
8135	0x6085.00	Quick stop deceleration CiA402	UDINT
8111	0x60B2.00	Torque offset CiA402	INT
8137	0x60FF.00	Target velocity CiA402	DINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
128	0x2155.09	Actual position value	LINT
113104	0x2197.05	Actual value of modulo	LINT
1210	0x2155.0B	Actual velocity value	REAL
526796	0x2168.17	Maximum torque symmetrical	REAL
7139	0x2162.0C	Resulting nominal torque	REAL
151	0x2157.02	Actual torque value gear shaft	REAL
8135	0x216F.08	Quick stop deceleration CiA402	REAL
8111	0x216F.01	Torque offset CiA402	REAL
8137	0x216F.0A	Target velocity CiA402	REAL
11413	0x217B.0E	Interpolation mode CSV	UDINT

Tab. 125 Objects

Objects in the different CSV operating modes

The objects marked with a dot are effective in the different CSV operating modes.

CSV	CSV-T	Objects
•	•	0x60FF
–	•	0x60B2

Tab. 126 Effective objects

Precondition for the cyclic synchronized velocity mode

The following conditions must be fulfilled for the cyclic synchronized velocity mode:

– Modes of operation display (0x6061) = 9
– Statusword (0x6061) = XX0X XX1X X011 0111$_b$

Monitoring

Object 0x6041: Statusword

The following statuses of cyclic synchronized velocity mode can be monitored with the object:

– Bit 12: HEPP follows the setpoint value (HEPP follows the command value)

Bit[1)]	Description
12	
HEPP follows the setpoint value (HEPP follows the command value)	
0	HEPP does not follow the setpoint value for internal reasons (e.g. because a safety function is active)
1	HEPP is in operation enabled status and follows the setpoint value.

1) Signal status: 0 = low; 1 = high

Tab. 127 Monitoring cyclic synchronized velocity mode

9.2.1.7.3 PROFIdrive

PNUs

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		
1210	6.0	Actual velocity value	Integer16
113104	28.0	Actual value of modulo	Integer32
Px.	**Manufacturer-specific parameters**		
128	11067.0	Actual position value	Integer64
113104	12117.0	Actual value of modulo	Integer64
1210	11311.0	Actual velocity value	FloatingPoint
526796	12166.0	Maximum torque symmetrical	FloatingPoint
7139	11704.0	Resulting nominal torque	FloatingPoint
151	11070.0	Actual torque value gear shaft	FloatingPoint

Tab. 128 PNUs

9.2.1.8 Cyclic synchronized force/torque mode (CST)

9.2.1.8.1 Function

The cyclic synchronized force/torque mode enables command values to be preset for the device in a fixed time grid using the drive profile (SYNC interval). The import of the setpoint values is synchronized with the synchronization signal of the higher-order controller. The synchronization signal is generally slower by a whole number than the cycle of the closed-loop controller. The synchronization time is generally set by the higher-order PLC (synchronization time 1 ... 20 ms, increment 1 ms, ➔ Px.1051). The integrated fine interpolator therefore calculates intermediate support points and derivations from the setpoint value for the closed-loop controller (interpolation).

Monitoring functions

The monitoring functions marked with a dot are effective in this operating mode:

Motion monitoring function status word			
Bit	Code	Name	Effective
0	TRX	Target window reaches position	–
1	TRV	Target window reaches velocity	–
2	TRT	Target window reaches torque	–
3	FEX	Following error position	–
4	FEV	Velocity following error	•
6	TMX	Position target area monitoring	–
7	TMV	Velocity target area monitoring	–
8	TMT	Torque target area monitoring	–
9...11	–	reserved	–
14			
15			
16	STX	Standstill monitoring position/velocity	•
17	STV	Standstill monitoring velocity	•
18	LS	Stop reached	•
19	STLP	Stroke limit reached positive	–
20	STLN	Stroke limit reached negative	–
21	VM	Speed monitoring	•
22	PB	Pushback monitoring	•
23	RDX	Remaining distance monitoring	–
24	MC	Trajectory completed	–
26	TUR	Torque utilization exceeded	–
27	FSPR	Fixed stop reached	–
28	ACC	Drive accelerated	–
29	DEC	Drive decelerated	–
30... 31	–	reserved	–

Tab. 129 Motion monitoring function

Detailed information on the monitoring functions ➔ 9.3 Motion monitoring.

Motion quantities

The path course of a positioning command is largely influenced by the following motion quantities:

Motion quantities	Description
Setpoint force/setpoint torque	The higher-order PLC supplies the setpoint force.

Tab. 130 Motion quantities

Triggering orders

– Fieldbus (direct mode)

Requirements

– Controller enable

Pilot control values

Pilot control values are generated by an internal algorithm.

The input and output values of the interpolator in the CST operating mode are shown in the following graph.

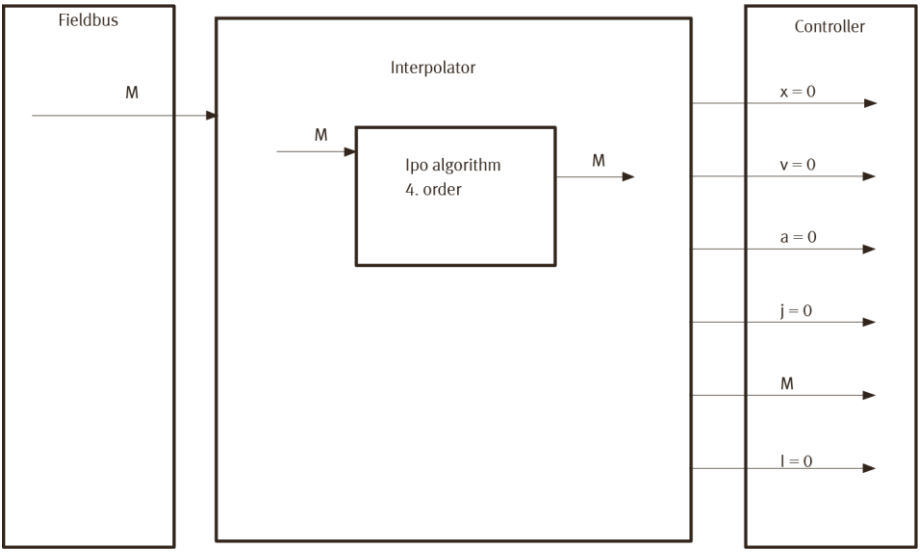


Fig. 34 CST operation

9.2.1.8.2 CiA 402

The following graphs show an overview of the objects involved in the cyclic synchronized force/torque mode and their interaction with the closed-loop controller.

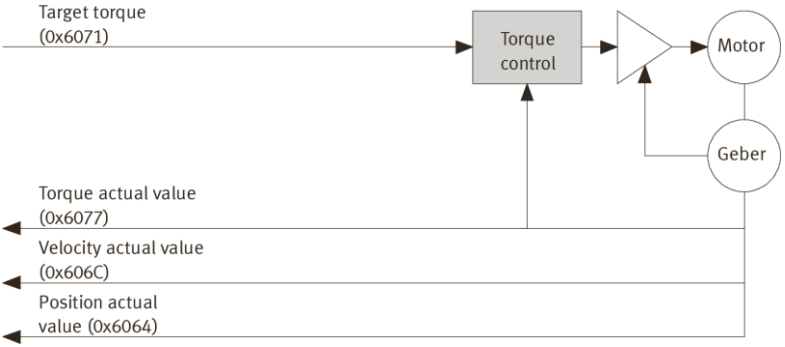


Fig. 35 Overview of the cyclic synchronized force/torque mode (CST)

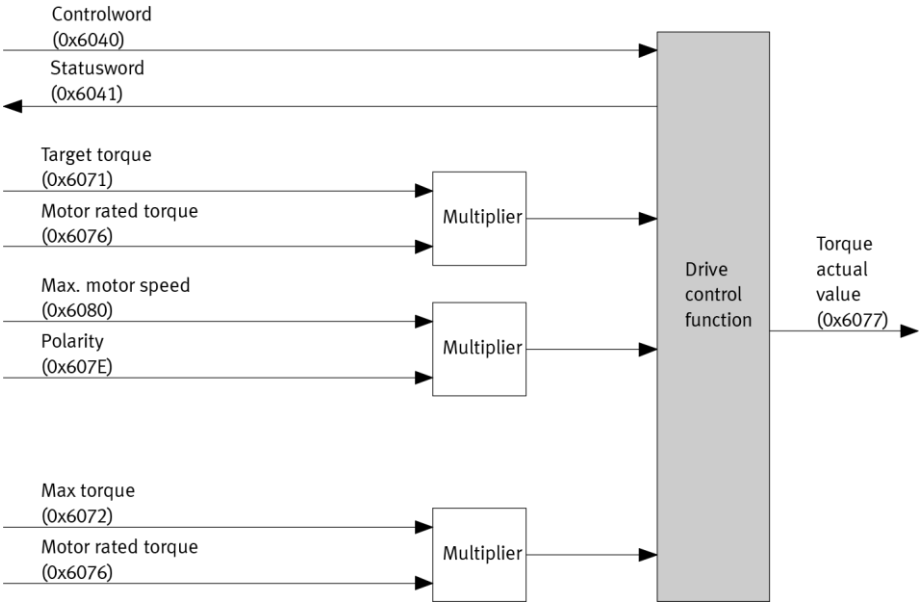


Fig. 36 Object overview of the cyclic synchronized force/torque mode (CST)

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
730	0x6040.00	Control word CiA402	UINT
731	0x6041.00	Status word CiA402	UINT
128	0x60E4.01	Actual position value	DINT
113104	0x6064.00	Actual value of modulo	DINT
1210	0x606C.00	Actual velocity value	DINT
526795	0x6071.00	Target torque CiA402	INT
526796	0x6072.00	Maximum torque symmetrical	UINT
151	0x6077.00	Actual torque value gear shaft	INT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
730	0x216D.01	Control word CiA402	UINT
731	0x216D.02	Status word CiA402	UINT
128	0x2155.09	Actual position value	LINT
113104	0x2197.05	Actual value of modulo	LINT
1210	0x2155.0B	Actual velocity value	REAL
526795	0x216F.0D	Target torque CiA402	REAL
526796	0x2168.17	Maximum torque symmetrical	REAL

Parameter	Index.Subindex	Name	Data type
151	0x2157.02	Actual torque value gear shaft	REAL

Tab. 131 Objects

Precondition for the cyclic synchronized force/torque mode

The following conditions must be fulfilled for the cyclic synchronized force/torque mode:

– Modes of operation display (0x6061) = 10
– Statusword (0x6061) = XX0X XX1X X011 0111b

Monitoring

Object 0x6041: Statusword

The following statuses of cyclic synchronized force/torque mode can be monitored with the object:

– Bit 12: HEPP follows the setpoint value (HEPP follows the command value)

Bit[1)] 12	Description
HEPP follows the setpoint value (HEPP follows the command value)	
0	HEPP does not follow the setpoint value (e. g. because a safety function is active)
1	HEPP in operation enabled status and follows the setpoint value

1) Signal status: 0 = low; 1 = high

Tab. 132 Monitoring cyclic synchronized force/torque operation

9.2.1.8.3 PROFIdrive

PNUs

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		
1210	6.0	Actual velocity value	Integer16
113104	28.0	Actual value of modulo	Integer32
Px.	**Manufacturer-specific parameters**		
128	11067.0	Actual position value	Integer64
113104	12117.0	Actual value of modulo	Integer64
1210	11311.0	Actual velocity value	FloatingPoint
526796	12166.0	Maximum torque symmetrical	FloatingPoint
151	11070.0	Actual torque value gear shaft	FloatingPoint

Tab. 133 PNUs

9.2.1.9 Switch-on/off behavior and closed-loop controller enable

9.2.1.9.1 Function

Parameters and diagnostic messages

ID Px.	Parameter	Description	
10231	Device status	Shows the status of controller enable. This means: – 0: not enabled – 1: enabled	
		Access	read/–
		Update	effective immediately
		Unit	–
10232	Controller enable selection	Specifies how the controller is to be enabled. This means: – 2: fieldbus For detailed information ➔ Tab. 135 Options for controller enable.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 134 Parameter

Parameter for selection of controller enable (Px.10232)			
Value	Enable via ...	Description	Operating mode after controller enable
2	Fieldbus	The request of controller enable is issued exclusively via the fieldbus.	Positioning mode

Tab. 135 Options for controller enable

If the device switches to operating mode on controller enable, a category 2 stop is executed ➔ 9.5.2 Classification of Diagnostic Events. After the switch-on delay has elapsed, new tasks can be processed.

9.2.1.9.2 CiA 402

Objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
10231	0x218E.01	Device status	UDINT
10232	0x218E.02	Controller enable selection	UDINT

Tab. 136 Objects

9.2.1.9.3 PROFIdrive

PNUs

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
10231	11800.0	Device status	Unsigned32
10232	11801.0	Controller enable selection	Unsigned32

Tab. 137 PNUs

9.2.2 Stop

9.2.2.1 Function

The stop command aborts the current motion command. The subsequent reactions to the stop command depend on what triggered the stop.

Stop command triggered by ...	Specific reaction
– Record table[1)]	– The motion command is aborted. – The HEPP gripper is decelerated to a stop using the parameterized stop ramp of the command record. – If the standstill monitoring (STC signal ➔ 9.3.5 Standstill monitoring) detects that the HEPP gripper has stopped moving on conclusion of the stop ramp, the closed- loop controller holds the gripper at that position.
– Device profile (direct) or – Diagnostic event of stop cat. 2	– The motion command is aborted. – The HEPP gripper is decelerated to a stop using the parameterized stop ramp. – If the standstill monitoring (STC signal ➔ 9.3.5 Standstill monitoring) detects that the HEPP gripper has stopped moving on conclusion of the stop ramp, the closed- loop controller holds the HEPP gripper at that position.
– Diagnostic event of stop cat. 1 or – Removal of controller enable	– The motion command is aborted. – The HEPP gripper is decelerated to a stop using the defined stop ramp. – If the standstill monitoring detects that the HEPP gripper has stopped moving on conclusion of the stop ramp, the brake locks and the closed-loop controller switches off after the elapse of the parameterized delay (Px.21 and Px.23 ➔ 9.1.3.1 Brake control). The HEPP gripper is switched off directly at standstill without the brake. – The HEPP gripper is uncontrolled.
– Diagnostic event of stop cat. 0	– The motion command is aborted. – The power stage is switched off. – The brake is actuated. – The HEPP gripper is uncontrolled.
Detection of software end position	Motion command is aborted, parameterized stop category is executed
Detection of stroke limit	

1) Only the PROFIdrive type HEPP support the function block for the record table.

Tab. 138 Specific reactions to the stop command

Detailed information on the general fault reactions to diagnostic events ➔ 9.5.2 Classification of Diagnostic Events.

With a stop via the record table or a category 2 stop:
– If the standstill monitor detects that the HEPP gripper has stopped moving, the closed-loop controller switches to position control and uses the actual position value as the new setpoint value.

Parameters and diagnostic messages

Information on parameterization of stop ramps via the record table ➔ 9.2.5 Order via record selection.

ID Px.	Parameter	Description	
12101	Stop ramp deceleration	Specifies the deceleration for stops that are triggered by the device profile or a category 1 and 2 diagnostic event. Information on the parameterization of the deceleration for direct stops via the device profile Ci402 ➔ 9.2.2.2 CiA 402. Information on the parameterization of the deceleration for direct stops via the device profile ➔ 9.2.2.3 PROFIdrive.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
12111	Stop ramp jerk	Specifies the jerk for stops that are triggered by the following: – Device profile (direct) – Category 1 or 2 diagnostic events.	
		Access	read/write
		Update	effective immediately
		Unit	user-defined

Tab. 139 Parameter

9.2.2.2 CiA 402

Objects for stopping

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
8135	0x6085.00	Quick stop deceleration CiA402	UDINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
8135	0x216F.08	Quick stop deceleration CiA402	REAL
12101	0x2180.01	Stop ramp deceleration	REAL
12111	0x2180.02	Stop ramp jerk	REAL

Tab. 140 Objects

Triggering and monitoring Object 0x6040: control word

The stop command is triggered via the object:

– bit 2: stop (quick stop)

The deceleration is specified by the 0x6085 object. For additional information ➔ 9.2.1 Operating modes.

Object 0x6041: status word

If stop has been requested and executed, bit 5 is reset to 0.

– Bit 5: stop (quick stop active)

For additional information ➔ 9.2.1 Operating modes.

9.2.2.3 PROFIdrive

PNUs for Stopping

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
12101	11834.0	Stop ramp deceleration	FloatingPoint
12111	11835.0	Stop ramp jerk	FloatingPoint

Tab. 141 PNUs

9.2.3 Hold

9.2.3.1 Function

The reactions to the hold command depend on the active operating mode. If the cyclic synchronized operation is active, the hold command is ignored. In other operating modes the current command is aborted by the hold command and continued when the command is withdrawn.

Information on the operating modes ➔ 9.2.1.2 Operating modes for performing motion commands.

The stop ramp for the hold command in a profile operating mode is determined by the parameters valid for the operating mode ➔ 9.2.2 Stop.

Operating modes	Reaction to ...	
	... the hold command	... Withdrawal of the hold command
– PP – P	– The motion command is interrupted. – The HEPP gripper is braked and remains position controlled stationary with reference to parameters v, a and j. – A message is generated.	– The motion command is continued with reference to parameters v, a and j.
– HM (homing)	– The motion command is interrupted. – The HEPP gripper is braked and remains position controlled stationary with reference to parameters v, a and j. – A message is generated.	– The homing is not continued.
– PV – V	– The motion command is interrupted. – The HEPP gripper is braked and remains position controlled stationary with reference to parameters a and j. – A message is generated.	– The motion command is continued with reference to parameters a and j.

Operating modes	Reaction to ...	
	... the hold command	... Withdrawal of the hold command
– PT, PT-B – T	– The motion command is interrupted. – The force is reduced braked and the HEPP gripper remains position-controlled stationary with reference to the force ramp. – A message is generated.	– The motion command is continued with reference to the force ramp.
– CSP – CSV – CST – Jogging	– The hold command is ignored.	– The withdrawal of the hold command is ignored.

Tab. 142 Reaction to the hold command

9.2.3.2 CiA 402

Triggering and monitoring

Object 0x6040: control word

The hold command is triggered via the object:

– Bit 8: hold (hold)

The deceleration is determined by the deceleration set in the operating mode. For additional information ➔ 9.2.1 Operating modes.

Object 0x6041: status word

If hold is requested and executed in the PV operating mode (current velocity 0), bit 12 is set to 1.

– Bit 12: velocity (speed)

If hold is requested and executed in other operating modes (current velocity 0), bit 10 is set to 1.

– Bit 10: target position reached (target reached)

For additional information ➔ 9.2.1 Operating modes.

9.2.3.3 PROFIdrive

Triggering and monitoring

Finite state machine application class 3 (STW1.5 Intermediate stop)

➔ Please refer to the CMMT-ST-SW manual 12.4.3.3 Finite State Machine Positioning Mode in Application Class 3.

9.2.4 Homing

9.2.4.1 Function

In order to be able to approach an absolute, unique position in the positioning range, the HEPP gripper must be homed to the dimensional reference system.

Homing of the HEPP gripper includes:

– Homing
– Definition of the HEPP/axis zero point
– Definition of the dimension reference system ➔ 9.1.2.5 Dimension reference system

Controller enable

A set controller enable is required for homing methods.

Reference mark

The reference mark is by default the absolute reference point for the dimensional reference system. A valid homing is required for all motion commands with the "position" target. Motion commands with the "velocity, torque and jogging" targets can be run without a valid homing.

Fig. 37 66 Symbol: reference mark

Homing

Homing is executed with the start using the "stop " homing methods.

HEPP/axis zero point move

HEPP/axis zero point move can be activated with the "Move to HEPP/axis zero point after homing" parameter. The HEPP/axis zero point move is run immediately after a valid homing if the HEPP/axis zero point offset ≠ 0.

- Parameters:
  - Stops and following errors:
  - The monitoring of stops and following errors is activated for the duration of HEPP/axis zero point move.

Homing status

In the following cases the "homing status" changes:

- The status is reset
  - At the start of a new homing
  - Every time the device is restarted with single-turn encoder
- The status is set
  - After a valid homing

Diagnostic parameters

ID Dx.	Name	Description
05 I 01 I 00056 (83951672)	Configuration of homing invalid	Parameterization of homing invalid
05 I 01 I 00057 (83951673)	Homing: Timeout	Homing: Timeout
05 I 01 I 00058 (83951674)	Homing search path exceeded	Homing search path exceeded

Tab. 143 Diagnostic homing

9.2.4.2 Timing

Homing to stop

The graph shows as an example of homing to the stop without zero pulse in a positive search direction and then move to the HEPP/axis zero point in a negative direction.

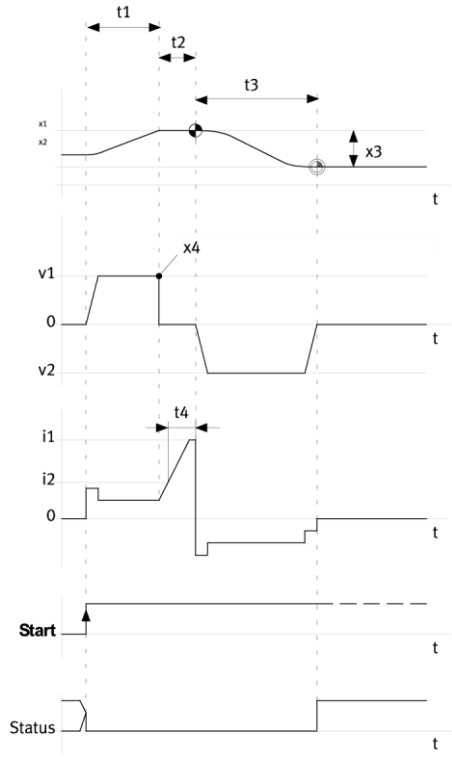


Fig. 38 Homing to stop

Name	Description
i1	Maximum current
i2	Percentage limit value of nominal current
t1	Duration of search
t2	Duration of stop detection
t3	Duration of move to the HEPP/axis zero point
t4	Setpoint value time monitoring window stop detection
v1	Target velocity search
v2	Target velocity move
x1	Reference mark stop

Name	Description
x2	HEPP/axis zero point
x3	HEPP/axis zero point offset
x4	Stop
Start	Start homing
Status	Referencing status

Tab. 144 Legend for homing to stop

9.2.4.3 Homing methods

9.2.4.3.1 Method Negative stop

The reference mark is found by detection of the stop.
Sequence:

1. Search stop: Stop is searched in the search direction at search velocity.
   The stop detection is parameterised via the parameters Px.8414 and Px.8415.
2. Set reference mark: Position of the stop is taken as the reference mark.
3. Set axis zero point: The axis zero point is set with reference to the reference mark.
4. Report status: "Homing status" is set.

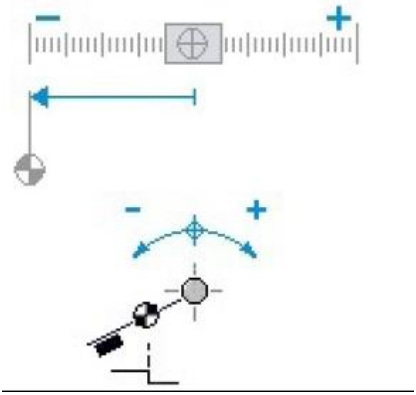


Fig. 39 Negative stop

9.2.5 Order via record selection

9.2.5.1 Record selection

9.2.5.1.1 Function

Only the PROFIdrive type of HEPP grippers have the function block for record table.

Command records can be saved in the device in a record table. The command records contain parameters for processing commands and can be addressed by a record number. To start a command record,

e.g. via the device profile, the controlling PLC only needs to send the record number and the start signal in the output data. The record table can be activated either as a foreground process or a background process. However, motion commands can only be run as a foreground process ➔ Tab. 149 Command record type parameter (ID Px.1810).

Start record table ...	Description
... as foreground process	All command record types can be executed, including motion commands. The event table can monitor events at the same time.
... as background pro cess	Motion commands are illegal and generate a category 1 stop. The event table can monitor events at the same time.

Tab. 145 Mode of record table

Besides the parameters for pure command processing, record selection offers the following options for influencing sequence control:

Options for sequence control	Description
Record switching	A start condition can be established for every record. The start condition specifies what the reaction should be to a start signal for the record if the current order has not been ended yet (abort, wait, ignore, Px.1838).
Record sequencing	Command sequences that can be started with a single start signal can be defined by sequencing records of the record table ➔ 9.2.5.2 Record sequencing.
Event table	The event table enables definition of the sequencing conditions that should also be monitored in parallel. (➔ 9.2.5.3 Monitoring of events).

Tab. 146 Options for sequence control

Mode of record table

– Possible as background or foreground process
– Maximum 3 record sequences per command record
– Depending on the product variant and firmware: up to 128 command records and up to 128 record sequences in total

The command records of the record table can be started as follows:

– The device profile of the higher-order controller
– The engineering interface, e.g. via the function block

Rules for processing

– The "write parameters" command record is always processed in one cycle and contains the start of the next order.
– The priority of the record sequences depends on the index of the data record in which the record sequence was created. Record sequences in data records with a smaller index have priority over record sequences in data records with a larger index. If conditions in multiple record sequences return the value "true" simultaneously, the record sequence in the data record with the smaller index is effective.

Timing

“Interrupt” start condition

The current order (here record A) is interrupted immediately and the newly addressed order (here record B) is then executed immediately.

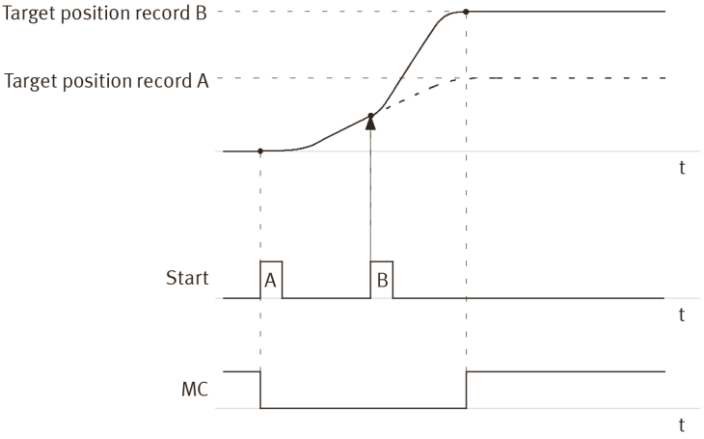


Fig. 40 “Interrupt” start condition (example)

Name	Description
Target position	Target position of the motion command
Record A, B, C	Record A, B or C
Start	Start record
MC	Motion complete

Tab. 147 Legend for the "Interrupt" start condition

Parameters and diagnostic messages

The index is the number of the internal data record in which the command record is saved. It is addressed externally via the record number, which is saved in the parameter Px.1811.

The "record table field 1 ... 7" parameters depend on the value of the record type parameter.

ID Px.	Parameter	Description	
1130224	Activation background mode	Specifies whether the record table is activated as a foreground process or a background process. ➔ Tab. 145 Mode of record table This means: – 0: foreground process – 1: background process	
		Access	read/write
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
1810	Command record type	Specifies the type of the command record. Px.1810.0.0: record type of data set 0 ... Px.1810.0.64: record type for data set 64 ... (depending on the product variant and the firmware) Permissible values ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1811	Record number	Specifies the record number with which the command record is to be addressed.	
		Access	read/write
		Update	effective immediately
		Unit	–
1812	Record table field 1	Specifies the value of the first parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1813	Record table field 2	Specifies the value of the second parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
1813	Record table field 2	Unit	–
1814	Record table field 3	Specifies the value of the third parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1815	Record table field 4	Specifies the value of the fourth parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
1816	Record table field 5	Specifies the value of the fifth parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1817	Record table field 6	Specifies the value of the sixth parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1818	Record table field 7	Specifies the value of the seventh parameter depending on the record type ➔ Tab. 149 Command record type parameter (ID Px.1810)	
		Access	read/write
		Update	effective immediately
		Unit	–
1838	Selection start condition record	Specifies the behavior on switching to another command record. This means: – 0: interrupt ➔ Fig. 40 The current order is interrupted immediately, and the newly addressed order is executed directly.	
		Access	read/write
		Update	effective immediately
		Unit	–
1846	Status of record table	Display the status of the current record. – 0: inactive – 1: new – 2: active – 3: executed – 5: buffered – 6: cancelled – 7: synchronized	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 148 Parameter

Parameters depending on the record type

The meaning of the record table field 1 ... record table field 7 parameters depends on the selected record type (value of the record type parameter).

Command record type parameter (ID Px.1810)			
Value	Command record type	Description	Parameters depending on the record type (record table field 1... 7)
0	Inactive	no operation	1. (none)
2	Stop ramp	Stop with parameterized brake ramp	1. Deceleration 2. Jerk
3	Homing	Start homing	1. Homing method as per CiA402 including manufacturer-specific methods
4	Velocity	Velocity mode with or without stroke limitation:	1. Target velocity 2. Acceleration 3. Deceleration 4. Jerk 5. Activation of stroke limitation: a) 0: inactive b) 1: active 6. Negative stroke limitation 7. Positive stroke limitation
5	Position	Positioning mode (absolute or relative):	1. Type of target specification: a) 0: absolute b) 1: relative to the current actual position c) 2: relative to the current setpoint position d) 3: relative to the last target position e) 4: relative to the current touch probe position instance 0 f) 5: relative to the current touch probe position instance 0 2. Target position 3. Profile velocity 4. Acceleration 5. Deceleration 6. Jerk 7. End velocity

Command record type parameter (ID Px.1810)			
Value	Command record type	Description	Parameters depending on the record type (record table field 1... 7)
7	Torque	Torque mode without or with stroke and velocity limitation	1. Target torque 2. Torque rise time 3. Velocity limit value 4. Activation of stroke limitation: – 0: inactive – 1: active 5. Negative stroke limitation 6. Positive stroke limitation
10	Flow control	Does not execute an action. Used as placeholder for appending record sequences.	– (none)
25	Torque with holding brake	Torque mode with holding brake set	1. Target torque 2. Torque rise time 3. Velocity limit value 4. Activation of stroke limitation: – 0: inactive – 1: active 5. Negative stroke limitation 6. Positive stroke limitation 7. Selection of holding brake – 0: holding brake 1
26	Cam controller	Activation of the cam controller (also allowed for background process)	1. Cam controller mode 2. Instance (number of the cam controller) 3. Trigger mode
28	Touch probe	Activate/deactivate position capture function (also allowed for background process)	1. Touch probe mode 2. Channel of trigger input: – 0: CAP0 – 1: CAP1
29	Modulo	Activates the modulo mode for positioning mode (PP)	1. Mode – 0: inactive – 1: shortest path – 3: shortest path within the modulo limit – 4: only positive path – 5: only negative path – 8: setting of the modulo position – 9: reset of the modulo position

Command record type parameter (ID Px.1810)			
Value	Command record type	Description	Parameters depending on the record type (record table field 1... 7)
30	Change close loop parameter set	Switch to another closed-loop controller parameter record (also allowed for background process)	1. Controller parameter set ID 2. Transition time
31	Set position status word 2	Sets the corresponding bit 10/11 in POS_ZSW, the corresponding status depending on the status ID 1/2 (only relevant for PROFIdrive).	1. Status ID 1 or 2 2. State – 0: inactive – 1: active
32	Moving to fixed stop	Activates the move to fixed stop mode.	1. Type of target specification: a) 0: absolute b) 1: relative to the current actual position c) 2: relative to the current setpoint position d) 3: relative to the last target position e) 4: relative to the current capture position 2. Target position 3. Profile velocity 4. Acceleration 5. Deceleration 6. Jerk
33	Move to fixed stop parameter	Defines the parameters for move to fixed stop.	1. Clamping torque 2. Clamping torque offset 3. Positive stroke limit 4. Negative stroke limit
34	Brake test	Activates the automatic brake test ➔ 9.5.1.10 Brake test.	– (none)

Tab. 149 Command record type parameter (ID Px.1810)

9.2.5.2 Record sequencing

9.2.5.2.1 Function

Sequencing multiple records of the record table enables specification of command sequences. A com mand sequence is executed after starting with no further start commands to the last record of the sequence. If the record table is activated as a foreground process, complex motion sequences and movement profiles can be created with command sequences, e.g.:

– Positioning and clamping in a motion sequence

– Moving a velocity profile
– Executing a force profile for pressing procedures

A maximum of 3 record sequences can be parameterized for every record of the record table. Every record sequence defines a condition and a subsequent record. The condition (comparator) can compare signals, states or parameters and is cyclically monitored. If one of the maximum of 3 conditions returns the value "true", the associated subsequent record is started.

Parameters for the sequence of command records of the record table

ID Px.	Parameter	Description	
1831	Record step enabling type	Specifies the enabling condition that is to be monitored along with the execution of the record. Possible record sequencing types ➔ Record sequencing type parameter (ID Px.1831).	
		Access	read/write
		Update	effective immediately
		Unit	–
1832	Record sequencing record number start	Specifies the number of the record from which the record sequence starts (maximum 3 record sequence per record).	
		Access	read/write
		Update	effective immediately
		Unit	–
1833	Record sequencing record number target	Specifies the number of the target record to which the record sequence is targeted (maximum 1 target record per record sequence).	
		Access	read/write
		Update	effective immediately
		Unit	–
1834	Record sequencing field time	Specifies the value of the time parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write
		Update	effective immediately
		Unit	s
1835	Record sequencing field 1	Specifies the value of the first comparator type-dependent parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write
		Update	effective immediately
		Unit	–
1836	Record sequencing field 2	Specifies the value of the second comparator type-dependent parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
1837	Current record table index	Shows the current record number.	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 150 Parameter

The record sequencing depends on the configured monitoring windows with a comparator that depends on a motion monitor.

Record sequencing type parameter (ID Px.1831)			
Value	Record sequencing types	The sequencing condition is achieved when ...	comparator type-dependent parameters
0	No comparator	– (comparator not specified)	– (none)
1	Target position reached	... the motion monitor reports that the target position has been reached.	– (none)
2	Target velocity reached	... the motion monitor reports that the target velocity has been reached.	– (none)
3	Target torque reached	... the motion monitor reports that the target torque has been reached.	– (none)
5	Position	... the actual position is within the pre-set window for the duration of the specified cushioning time.	1. lower limit 2. upper limit 3. Cushioning time
6	Velocity	... the actual velocity is within the pre-set window for the duration of the specified cushioning time.	1. lower limit 2. upper limit 3. Cushioning time
7	Torque	... the actual torque is within the pre-set window for the duration of the specified cushioning time.	1. lower limit 2. upper limit 3. Cushioning time
9 ... 12	reserved		
13	Parameters	... the result of the parameterized comparison operation returns "true" (comparison of parameter and value).	1. Cushioning time 2. Parameter ID 3. Operation a) 0: within the range b) 1: outside the range c) 2: greater than

Record sequencing type parameter (ID Px.1831)			
Value	Record sequencing types	The sequencing condition is achieved when ...	comparator type-dependent parameters
			d) 3: less than 3. lower limit 4. upper limit
14	Time	... the duration measured from the start of the command is equal to or greater than the specified duration.	1. Duration
15	MC	... the record is terminated by the trajectory generator.	– (none)
16	Execution completed	... the status of the order corresponds to DONE. With a motion command, DONE corresponds to the status of target window reached (Target Reached = TRUE)	– (none)
17	Movement monitoring status word		– And (4), Or (5) operator – Bit mask (32-bit)
18	Touch probe detected	The activated touch-probe function has detected a valid event.	1. No. of the capture channel
19	Control word 1 BLOCK CHANGE	... in control word STW1.13 there is an edge change from 0 to 1.	
20	Fixed stop reached	... the fixed stop was detected	– (none)
21	Drive decelerated	... the HEPP drive decelerates	
22	Positive stroke limit reached	... the positive stroke limit has been reached	
23	Negative stroke limit reached	... the negative stroke limit has been reached	

Tab. 151 Record sequencing type parameter (ID Px.1831)

9.2.5.3 Monitoring of events

9.2.5.3.1 Function

The event table enables the monitoring of events that are to be monitored parallel to the sequencing conditions of the current command record. If the event occurs, the current command record of the record table is interrupted and branched to the record of the record table that was defined in the event table. Characteristics of the event table:

– max. 16 events

Rules for processing

– The priority is ascending and depends on the index. Events in data records with a smaller index

have priority over events in data records with a larger index. If multiple events occur simultaneously, it branches to the record that is saved in the data record with the smaller index. Priority:
Data record with Index 0 has the highest priority: Px.1841.0.0
...
Data record with Index 15 has the lowest priority: Px.1841.0.15

Parameters and diagnostic messages

The index is the number of the internal data record in which the event is saved.

ID Px.	Parameter	Description	
1840	Activate Event table	Enables activation of event monitoring – 1 = activate – 0 = deactivate	
		Access	read/write
		Update	effective immediately
		Unit	–
1841	Event type	Specifies the type of step enabling condition. The same step enabling conditions as with record sequences can be used. Possible record sequencing types ➔ Record sequencing type parameter (ID Px.1831).	
		Access	read/write
		Update	effective immediately
		Unit	–
1842	Next event target	Specifies the number of the target record to which the step enabling condition is targeted (maximum 1 target record per event).	
		Access	read/write
		Update	effective immediately
		Unit	–
1843	Next event field time	Specifies the value of the "time" parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write
		Update	effective immediately
		Unit	s
1844	Next event field 1	Specifies the value for the first comparator type-dependent parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write
		Update	effective immediately
		Unit	–
1845	Next event field 2	Specifies the value for the second comparator type-dependent parameter ➔ Record sequencing type parameter (ID Px.1831)	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 152 Parameter

Diagnostic messages

ID Dx.	Name	Description
06 I 00 I 00070 (100663366)	Invalid record table parameter	A record table parameter is invalid
06 I 00 I 00083 (100663379)	Record table incorrect	Record table incorrect

Tab. 153 Diagnostic messages

9.2.5.4 PROFIdrive

PNUs of command record table

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1130224	12182.0	Activation background mode	Boolean
1810	11380.0 ... 127	Command record type	Unsigned32
1811	11381.0 ... 127	Record number	Integer32
1812	11382.0 ... 127	Record table field 1	Integer64
1813	11383.0 ... 127	Record table field 2	Integer64
1814	11384.0 ... 127	Record table field 3	Integer64
1815	11385.0 ... 127	Record table field 4	Integer64
1816	11386.0 ... 127	Record table field 5	Integer64
1817	11387.0 ... 127	Record table field 6	Integer64
1818	11388.0 ... 127	Record table field 7	Integer64
1838	11396.0 ... 127	Selection start condition record	Unsigned32
1846	11404.0	Status of record table	Unsigned32

Tab. 154 PNUs

PNUs of command record sequence

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1831	11389.0 ... 127	Record step enabling type	Unsigned32
1832	11390.0 ... 127	Record sequencing record number start	Integer32
1833	11391.0 ... 127	Record sequencing record number target	Integer32
1834	11392.0 ... 127	Record sequencing field time	FloatingPoint
1835	11393.0 ... 127	Record sequencing field 1	Integer64
1836	11394.0 ... 127	Record sequencing field 2	Integer64
1837	11395.0	Current record table index	Integer32

Tab. 155 PNUs

PNUs of command record event table

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1840	11398.0	Activate Event table	Boolean
1841	11399.0 ... 15	Event type	Unsigned32
1842	11400.0 ... 15	Next event target	Integer32
1843	11401.0 ... 15	Next event field time	FloatingPoint
1844	11402.0 ... 15	Next event field 1	Integer64
1845	11403.0 ... 15	Next event field 2	Integer64

Tab. 156 PNUs

9.2.6 Jog mode

9.2.6.1 Function

The HEPP gripper can move to any position in jog mode. The HEPP gripper is moved during jogging until the command for jogging is pending. If a command is not pending, a stop is initiated.
The following commands are available:
– Jogging 1 (positive direction)
– Jogging 2 (negative direction)
The motion limits for jogging with referenced HEPP grippers are monitored by the software end positions. If the HEPP gripper is in an invalid positioning range (outside the software limit switches), it may only move in the direction of the valid positioning range. In this state, jogging commands in the direction of the invalid positioning range are ignored.
If by jogging the HEPP gripper moves further in the blocked direction, the set message is generated depending on the software end position monitoring function.

Tasks

Jogging mode supports the following tasks:
– Approaching teach positions (e. g. in commissioning)
– HEPP free running (e.g. after a system malfunction)
– Manual positioning as standard operating mode

Feedback

Standstill monitoring STV.

Phases

Different jogging variants are possible depending on the device profile and parameterization:
– One phase (slow only or fast only)
– 2 phases (slow first then fast)
– Symmetrical dynamic value record, same dynamic values for jogging 1 (positive direction) and jogging 2 (negative direction)
– Asymmetrical dynamic value record, different dynamic values for jogging 1 (positive direction) and jogging 2 (negative direction)
– Incremental (relative positioning at specific distance – for PROFIdrive AC3 only)

Timing

The jogging motion consists of the following motion phases for jogging in 2 phases:

– Phase 1: motion at a slower velocity for precise positioning motions. (dynamic parameter record "slow")
– Phase 2: motion at a faster velocity for fast traversing through longer distances. (dynamic parameter record "fast")
– Phase 3: motion is stopped.

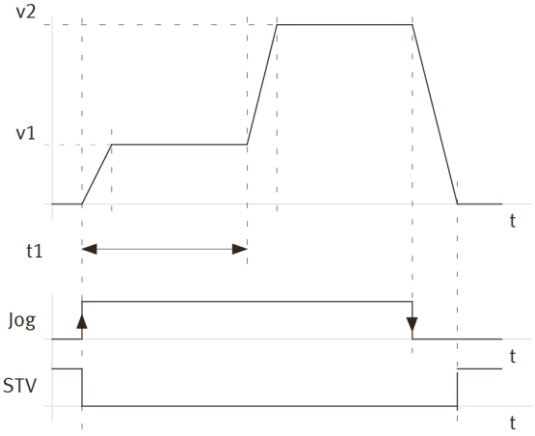


Fig. 41 Jog mode timing graph (example)

Name	Description	ID Px.
Jog	Command for jogging (positive example)	–
STV	Standstill monitoring signal	–
v1	Slow jog 1 velocity	1511
	Slow jog 2 velocity	214535
v2	Fast jog 1 velocity	1514
	Fast jog 2 velocity	214540
t1	Jog duration 1 movement	1510
	Jog duration 2 movement	214539

Tab. 157 Legend for jog mode timing graph

Symmetrical	Command	Additional parameters
Yes	Jogging 1 (+) Jogging 1 (-)	Px.1510 (Jog duration 1 movement)
No	Jogging 1 (+)	
No	Jogging 2 (-)	Px.214539 (Jog duration 2 movement)

Tab. 158 Parameters for time period t1

The mode switches between symmetrical and asymmetrical with the Px.214526.0.0 parameter: Symmetrical (default setting): the same dynamic parameter record is used for negative and positive. The

velocity sign is set automatically. (phase 1: 1 slow, -1 slow; phase 2: 1 fast, -1 fast) Asymmetrical: there is a separate dynamic parameter record for negative and positive (phase 1: 1 slow, 2 slow; phase 2: 1 fast, 2 fast)

Design	**Px.214526.0.0 (value)[1)]**	**Command**	**Dynamic value record**	
			Phase 1	Phase 2
Static slow	1	Jogging 1 (+)	1 slow	–
	1	Jogging 2 (-)	-1 slow	
	0	Jogging 1 (+)	1 slow	
	0	Jogging 2 (-)	2 slow	
Static fast	1	Jogging 1 (+)	1 fast	
	1	Jogging 2 (-)	-1 fast	
	0	Jogging 1 (+)	1 fast	
	0	Jogging 2 (-)	2 fast	
2-phase	1	Jogging 1 (+)	1 slow	1 fast
	1	Jogging 2 (-)	-1 slow	-1 fast
	0	Jogging 1 (+)	1 slow	1 fast
	0	Jogging 2 (-)	2 slow	2 fast

1) 0 = asymmetrical; 1 = symmetrical

Tab. 159 Overview of the supported commands

Dynamic value record	**Prefix**	**Velocity**	**Acceleration**	**Jerk**
		Px.	Px.	Px.
1 slow	+	1511	1512	1513
-1 slow	-	1511	1512	1513
2 slow	+	214535	214536	214537
1 fast	+	1514	1515	1516
-1 fast	-	1514	1515	1516
2 fast	+	214540	214541	214542

Tab. 160 Overview of dynamic parameters

Parameters and diagnostic messages

ID Px.	**Parameter**	**Description**	
1510	Jog duration 1 movement	Duration of phase 1 from detection of the command to jogging to switch over to phase 2. After elapse of the period the HEPP gripper accelerates in phase 2 to the velocity for faster movement.	
		Access	read/write
		Update	effective immediately
		Unit	s
1511	Slow jog 1 velocity	Maximum velocity during phase 1.	

ID Px.	Parameter	Description	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1512	Slow jog 1 acceleration	Acceleration (and deceleration) during phase 1.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1513	Slow jog 1 jerk	Jerk during phase 1.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1514	Fast jog 1 velocity	Maximum velocity during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1515	Fast jog 1 acceleration	Acceleration (and deceleration) during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1516	Fast jog 1 jerk	Jerk during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
214526	Activation of symmetrical jog	If activation is set, this means that the dynamic values for jog 1 are used for the two jog motions (positive/negative direction). If activation is not set, the dynamic values for jog 1 or jog 2 will be used for every jog motion.	
		Access	read/write
		Update	effective immediately
		Unit	–
214535	Slow jog 2 velocity	Maximum velocity during phase 1.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
214536	Slow jog 2 acceleration	Acceleration (and deceleration) during phase 1.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

ID Px.	Parameter	Description	
214537	Slow jog 2 jerk	Jerk during phase 1.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
214539	Jog duration 2 movement	Duration of phase 1 from detection of the command to jogging to switch over to phase 2. After elapse of the period the HEPP gripper accelerates in phase 2 to the velocity for faster movement.	
		Access	read/write
		Update	effective immediately
		Unit	s
214540	Fast jog 2 velocity	Maximum velocity during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
214541	Fast jog 2 acceleration	Acceleration (and deceleration) during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
214542	Fast jog 2 jerk	Jerk during phase 2.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
526917	Jogging state	Reports the status of the HEPP in jog mode. Value list: – 0: Jogging 1 with 2 movement phases – 1: Jogging 2 with 2 movement phases – 2: Stop jogging – 3: Jogging 1 fast – 4: Jogging 2 fast – 5: Jogging 1 slow – 6: Jogging 2 slow – 7: Incremental jog 1 – 8: Incremental jog 2 – 9: Velocity halt jog 1 – 10: Velocity halt jog 2 – 11: Velocity jog 1 – 12: Velocity jog 2	
		Access	read/–
		Update	effective immediately

ID Px.	Parameter	Description	
526917	Jogging state	Unit	–

Tab. 161 Parameter

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.2.6.2 CiA 402

Objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
1510	0x2186.01	Jog duration 1 movement	REAL
1511	0x2186.02	Slow jog 1 velocity	REAL
1512	0x2186.03	Slow jog 1 acceleration	REAL
1513	0x2186.04	Slow jog 1 jerk	REAL
1514	0x2186.05	Fast jog 1 velocity	REAL
1515	0x2186.06	Fast jog 1 acceleration	REAL
1516	0x2186.07	Fast jog 1 jerk	REAL
526917	0x2186.08	Jogging state	UDINT
214526	0x2186.09	Activation of symmetrical jog	BOOL
214535	0x2186.12	Slow jog 2 velocity	REAL
214536	0x2186.13	Slow jog 2 acceleration	REAL
214537	0x2186.14	Slow jog 2 jerk	REAL
214539	0x2186.16	Jog duration 2 movement	REAL
214540	0x2186.17	Fast jog 2 velocity	REAL
214541	0x2186.18	Fast jog 2 acceleration	REAL
214542	0x2186.19	Fast jog 2 jerk	REAL

Tab. 162 Objects

Control and monitoring

Basic functions for jogging ➔ 9.2.6.1 Function.

Requirements

– Controller enable (status Operation enabled)
– Jog operation is activated: object 0x6060 Modes of operation CiA402 = –3.
  Feedback: object 0x6061 Modes of operation display CiA402 = –3.

Control

The object 0x6040 Control word CiA402 has the following specific bits in jog operating mode:

Bit	Name	Description
4	Jog positive	Jogging 1 (positive direction)

Bit	Name	Description
5	Jog negative	Jogging 2 (negative direction)
11	Jog with velocity 1	Optional: if the bit is set, jogging is with the dynamic values for slow motion.
12	Jog with velocity 2	Optional: if the bit is set, jogging is with the dynamic values for fast motion.

Tab. 163 Specific bits for jogging in the control word

If bits 4 and 5 are both set, the HEPP gripper does not move. If another bit is also set during an active jog motion, the HEPP gripper stops.
Bits 11 and 12 also control the slow and fast velocity for jogging with a motion phase. If both bits are not set, movement is first slow then fast (jogging with 2 motion phases). If both bits are set, there is no motion.
The following dynamic values are applied depending on the Px.214526.0.0 parameter:

Bit 11 / 12	Px.214526.0.0 (value)1)	Command	Dynamic value record		Additional parameters
			Phase 1	Phase 2	
0 / 0	1	Jog positive	1 slow	1 fast	1510, Jog duration 1 movement
0 / 0	1	Jog negative	-1 slow	-1 fast	
0 / 0	0	Jog positive	1 slow	1 fast	
0 / 0	0	Jog negative	2 slow	2 fast	214539 Jog duration 2 movement
1 / 0	1	Jog positive	1 slow	–	–
1 / 0	1	Jog negative	-1 slow		
1 / 0	0	Jog positive	1 slow		
1 / 0	0	Jog negative	2 slow		
0 / 1	1	Jog positive	1 fast		
0 / 1	1	Jog negative	-1 fast		
0 / 1	0	Jog positive	1 fast	–	–
0 / 1	0	Jog negative	2 fast		

1) 0 = asymmetrical; 1 = symmetrical

Tab. 164 Overview of the supported parameter combinations

Monitoring

The object 0x6041 Status word CiA402 has the following specific bits in jog operating mode:

Bit	Name	Description
10	STV	Jogging not active (before or after the motion)
12	Velocity 1 jog	Motion with the dynamic values for slow motion
13	Velocity 2 jog	Motion with the dynamic values for fast motion

Tab. 165 Specific bits for jogging in the status word

9.2.6.3 PROFIdrive

The jogging function has the following special features from PROFIdrive:
– Jogging in 2 phases can be activated via the parameter Px.100010.
– Jogging of a parameterized distance (can be switched with POS_STW2.5 incremental jogging; applicable only for AC3 with additional parameters).
– If STW1.8 and STW1.9 are both set, the HEPP gripper does not move. If another bit is also set during an active jog motion, the HEPP gripper stops.

Additional parameters and diagnostic messages

PNUs of jog mode

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1511	11352.0	Slow jog 1 velocity	FloatingPoint
1512	11353.0	Slow jog 1 acceleration	FloatingPoint
1513	11354.0	Slow jog 1 jerk	FloatingPoint
100010	12679.0	Activation jog 2 phases	Boolean
214526	12126.0	Activation of symmetrical jog	Boolean
214530	12127.0	Relative position jog 1	Integer64
214535	12128.0	Slow jog 2 velocity	FloatingPoint
214536	12129.0	Slow jog 2 acceleration	FloatingPoint
214537	12130.0	Slow jog 2 jerk	FloatingPoint
214538	12131.0	Relative position jog 2.	Integer64

Tab. 166 PNUs

Starting from the value of the Px.214526.0.0 parameters, the following values are used depending on the application class.

Value of Px. 214526.0.0[1)]	Commands	Dynamic value record	Additional parameters
1	STW1.8 Jogging 1	1 slow	–
1	STW1.9 Jogging 2	-1 slow	
0	STW1.8 Jogging 1	1 slow	
0	STW1.9 Jogging 2	2 slow	

1) 0 = asymmetrical; 1 = symmetrical

Tab. 167 Overview of the supported commands for application class AC1

POS_STW2.5 (value)[1)]	Px.214526.0.0 (value)[2)]	Commands	Dynamic value record	Additional parameters
0	1	STW1.8 Jogging 1	1 slow	–
0	1	STW1.9 Jogging 2	-1 slow	
0	0	STW1.8 Jogging 1	1 slow	
0	0	STW1.9 Jogging 2	2 slow	

POS_STW2.5 (value)[1]	Px.214526.0.0 (value)[2]	Commands	Dynamic value record	Additional parameters
1	1	STW1.8 Jogging 1	1 slow	Px.214530.0.0 Relative position jog 1
1	1	STW1.9 Jogging 2	-1 slow	
1	0	STW1.8 Jogging 1	1 slow	
1	0	STW1.9 Jogging 2	2 slow	Px.214538.0.0 Relative position jog 2.

1) 0 = jogging velocity; 1 = incremental jogging
2) 0 = asymmetrical; 1 = symmetrical

Tab. 168 Overview of the supported commands for application class AC3

Control and monitoring

Jog operation is controlled by the following 3 bits of the control word 1 or control word 2.

Px.	Name	Description	PNU
1147080	12237.0	STW1.8 Jogging 1	Boolean
1147090	12238.0	STW1.9 Jogging 2	Boolean
112412100	12360.0	POS_ZSW1.10 Jogging active	Boolean
112414050	12384.0	POS_STW2.5 Jogging incremental active	Boolean

Tab. 169 Control and Status Words

If one of the bits STW1.8 and STW1.9 is set and the other bit is also set, the ramp is frozen to the current speed. If the bits STW1.8 and STW1.9 are set simultaneously, jog operation is not executed.
Two independent parameter sets are valid for jogging operation. The direction of the two motions is defined exclusively by the sign of the velocities (velocity 1 and velocity 2).

9.3 Motion monitoring

9.3.1 Motion monitoring functions

The motion monitoring functions monitor the HEPP gripper and protect the HEPP components against damage. Each motion monitoring function reads out values from the HEPP gripper and compares them to the expected behavior (e.g. threshold value).
The actual values from the actual value management, the setpoint values (determined between the pilot control and directional lock), as well as the target values and configuration of the actual command are imported to monitor the motion.
All of the motion monitoring functions are executed in parallel during this process. Which of the functions will cause an error response is dependent on the operating mode.

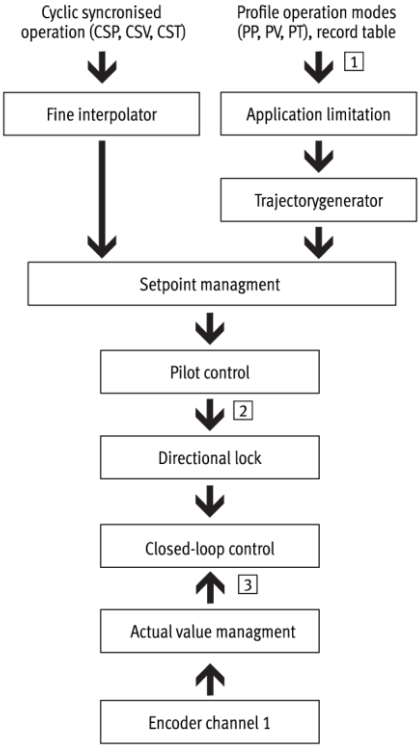


Fig. 42 Determining the target, setpoint and actual values

Name	Description
1 Target values	Parameterized setpoint value of the trajectory during profile operation
2 Setpoint	Setpoint values that change with time The setpoint values are determined between the pilot control and directional lock.
3 Actual value	Actual values that change with time The actual values are determined by actual value management.

Tab. 170 Legend for determining the target, setpoint and actual values diagram

The monitoring result is issued as follows:
- As a status signal
- As a directional lock when software end positions are exceeded
- As a diagnostic message with parameterizable error response (in the event of an error) Diagnostic messages can be disabled if necessary.

Overview

Code	Motion monitoring function		Detailed information
TR	Target window reached		➔ 9.3.2 Target Window Reached
TRX		Position	
TRV		Velocity	
TRT		Torque	
FE	Following error		➔ 9.3.3 Following error
FEX		Position	
FEV		Velocity	
TM	Target area monitoring		➔ 9.3.4 Target area monitoring
TMX		Position	
TMV		Velocity	
TMT		Torque	
ST	Standstill monitoring		➔ 9.3.5 Standstill monitoring
STX		Position/speed	
STV		Velocity	
LS	Stop reached		➔ 9.3.6 Stop reached
STL	Stroke limit reached		➔ 9.3.7 Stroke limit reached
STLP		Positive	
STLN		Negative	
VM	Speed monitoring		➔ 9.3.8 Speed monitoring (spinning protection)
PB	Pushback monitoring		➔ 9.3.9 Pushback monitoring
RDX	Remaining distance monitoring		➔ 9.3.10 Remaining distance monitoring
MC	Trajectory completed		➔ 9.3.11 Trajectory completed
TUR	Torque utilization exceeded		Status display
FSPR	Fixed stop reached		
ACC	Drive accelerated		
DEC	Drive decelerated		

Tab. 171 Overview of motion monitoring functions

Status word (Px.460)

The status of each motion monitoring function is provided in a status word within a bit, e.g. to continue commands based on the "Target reached" signal.
If a bit is set (1), the result for the associated motion monitoring function is "true". The status word can be displayed via the Px.460 parameter.

Status word bit allocation[1)]		
Bit	Code	Name
0	TRX	Target window reaches position
1	TRV	Target window reaches velocity
2	TRT	Target window reaches torque
3	FEX	Following error position
4	FEV	Velocity following error
6	TMX	Position target area monitoring
7	TMV	Velocity target area monitoring
8	TMT	Torque target area monitoring
9 ... 11	–	reserved
14		
15		
16	STX	Standstill monitoring position/velocity
17	STV	Standstill monitoring velocity
18	LS	Stop reached
19	STLP	Stroke limit reached positive
20	STLN	Stroke limit reached negative
21	VM	Speed monitoring
22	PB	Pushback monitoring
23	RDX	Remaining distance monitoring
24	MC	Trajectory completed
26	TUR	Torque utilization exceeded
27	FSPR	Fixed stop reached
28	ACC	Drive accelerated
29	DEC	Drive decelerated
30 ... 31	–	reserved

1) Assignment identical to configuration word

Tab. 172 Bit assignment status word

Bits 9 ... 11 and 30 ... 31 are reserved.

Configuration word (Px.461)

Diagnostic messages (e.g. following error) that are not required in certain operating situations can be disabled via the configuration word. The configuration word is a bitmask. If the bit for the associated motion monitoring function is set (1), the associated motion monitoring function may issue a diagnostic message and activate limits (e.g. directional lock). Without a diagnostic message, the bit is of no significance to the motion monitoring functions. The configuration word is specified by the Motion Se-

quence Control (MSC) component depending on the motion command and parameterization of the positioning block and is transmitted as part of the command.

Configuration word bit assignment[1)]		
Bit	Code	Name
0	TRX	Target window reaches position
1	TRV	Target window reaches velocity
2	TRT	Target window reaches torque
3	FEX	Following error position
4	FEV	Velocity following error
6	TMX	Position target area monitoring
7	TMV	Velocity target area monitoring
8	TMT	Torque target area monitoring
9 ... 11	–	reserved
14		
15		
16	STX	Standstill monitoring position/velocity
17	STV	Standstill monitoring velocity
18	LS	Stop reached
19	STLP	Stroke limit reached positive
20	STLN	Stroke limit reached negative
21	VM	Speed monitoring
22	PB	Pushback monitoring
23	RDX	Remaining distance monitoring
24	MC	Trajectory completed
26	TUR	Torque utilization exceeded
27	FSPR	Fixed stop reached
28	ACC	Drive accelerated
29	DEC	Drive decelerated
30 ... 31	–	reserved

1) Assignment identical to status word

Tab. 173 Configuration word bit assignment

Bits 9 ... 11 and 26 ... 31 are reserved.

Message types

Message type	**Description**
Status messages	Signal relating to an event or state to advance the internal state machine.

Message type	Description
Diagnostic messages	Signal relating to a malfunction or error, in part with parameterizable error responses. – Ignore – Info – Warning – Stop category 0 – Stop category 1 – Stop category 2

Tab. 174 Message types

Parameter

ID Px.	Parameter	Description	
460	Movement monitoring status	Status of movement monitoring	
		Access	read/–
		Update	effective immediately
		Unit	–
461	Configuration word movement monitoring	Configuration word for the movement monitoring	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 175 Parameter

9.3.1.1 CiA 402

Objects for status word and configuration word

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
460	0x2166.01	Movement monitoring status	UDINT
461	0x2166.02	Configuration word movement monitoring	UDINT

Tab. 176 Objects

9.3.1.2 PROFIdrive

PNUs for status word and configuration word

Parameter	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
460	11144.0	Movement monitoring status	Unsigned32
461	11145.0	Configuration word movement monitoring	Unsigned32

Tab. 177 PNUs

9.3.2 Target Window Reached

Target Reached TRx

The function indicates whether the target value has been reached following the start of a command. Depending on the operating mode, various target values are monitored simultaneously with a comparator during this process. Each comparator is defined by a monitoring window and the damping time. The damping time is set via the same parameter in all operating modes.

Timing

Status signal	TR...
Initial state of TRX, TRV, TRT signals	= 1
The signal is set under the following conditions: – The difference (current actual value / target value) is within the monitoring window – AND this condition is fulfilled for at least the specified damping time. The signal remains set until a new command is started. For positioning commands with a final velocity that is not equal to 0, the signal is set if the target position is reached and the final velocity remains in the monitoring window for the duration of the damping time.	0→1
The signal is reset under the following conditions: – A command is started. If the command has already been executed and it is restarted, all of the corresponding signals are reset and then set again for at least one cycle of the HEPP gripper (typ ically 1 ms).	1→0

Tab. 178 Status Signals - Target Window Reached (Dependent on Operating Mode)

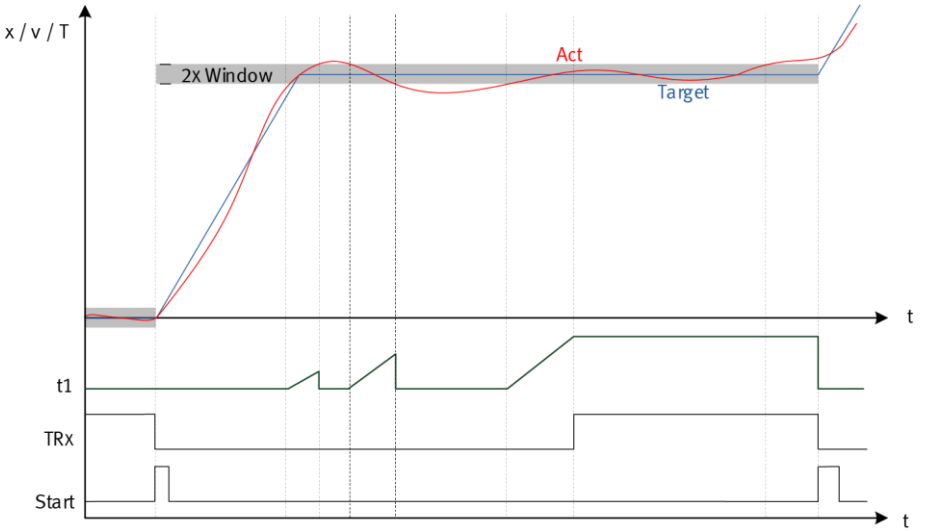


Fig. 43 Timing diagram: target window reached (example)

Name	Description
x/v/T	Position, velocity and torque motion quantities
t1	Damping time
TRx	Diagnostic message
Start	Start motion command
Window	Monitoring window
Act	Actual value
Target	Target value

Tab. 179 Legend for Timing diagram: target window reached (example)

Parameters and Diagnostic Messages

ID Px.	Parameter	Description	
468	Damping time target reached	Specifies the damping time for the target position, velocity and torque. The signal is set if the actual value for the specified duration is in the monitoring window. The signal remains set if the actual value moves outside the monitoring window during the specified duration. The damping time is reevaluated when the value returns to the window.	
		Access	read/write
468	Damping time target reached	Update	effective immediately
		Unit	s
469	Monitoring window target position	Specifies the monitoring window for the target position. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4610	Monitoring window target velocity	Specifies the monitoring window for the target velocity. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4611	Monitoring window target torque	Specifies the monitoring window for the target torque. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	Nm

Tab. 180 Parameters - Target Window Reached

ID Dx.	Name	Description
07 I 02 I 00121 (117571705)	Target position reached	Target position reached
07 I 02 I 00122 (117571706)	Target velocity reached	Target velocity reached
07 I 02 I 00123 (117571707)	Target torque reached	Target torque reached

Tab. 181 Diagnostic Messages - Target Window Reached

9.3.2.1 CiA 402

Objects - Target Window Reached

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
468	0x6068.00	Damping time target reached	UINT
469	0x6067.00	Monitoring window target position	UDINT
4610	0x606D.00	Monitoring window target velocity	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
468	0x2166.09	Damping time target reached	REAL
469	0x2166.0A	Monitoring window target position	REAL
4610	0x2166.0B	Monitoring window target velocity	REAL
4611	0x2166.0C	Monitoring window target torque	REAL

Tab. 182 Objects

9.3.2.2 PROFIdrive

PNUs of Target Window Reached

Parameter	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
468	11152.0	Damping time target reached	FloatingPoint
469	11153.0	Monitoring window target position	FloatingPoint
4610	11565.0	Monitoring window target velocity	FloatingPoint
4611	11566.0	Monitoring window target torque	FloatingPoint

Tab. 183 PNUs

9.3.3 Following error

Following error FEx

The difference between the setpoint value and actual value is monitored by the following error monitor. The position and speed are monitored simultaneously with a comparator during this process. The comparator is defined by a monitoring window and damping time. Following error monitoring is active as long as the target has not been reached (target reached = FALSE). Target area monitoring is then active ➔ 9.3.4 Target area monitoring

Parameters and diagnostic messages

ID Px.	Parameters	Description	
462	Damping time position: following error	Specifies the damping time for the position following error. The signal is set if the position difference for the specified duration is outside the monitoring window. If the position difference is within the monitoring window, the required damping time restarts when the difference is outside the window again.	
		Access	read/write
		Update	effective immediately
		Unit	s
463	Monitoring window position: following error	Specifies the monitoring window for the position following error. The monitoring window is set symmetrically to the setpoint value pattern (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
464	Monitoring window velocity: following error	Specifies the monitoring window for the velocity following error. The monitoring window is set symmetrically to the setpoint value pattern (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4682	Current position: following error	Specifies the current position following error.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
4683	Current velocity: following error	Specifies the current velocity following error.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
4690	Damping time velocity: following error	Specifies the damping time for the velocity following error. The signal is set if the velocity difference for the specified duration is outside the monitoring window. If the velocity difference is with in the monitoring window, the required damping time restarts when the difference is outside the window again.	
4690	Damping time velocity: following error	Access	read/write
		Update	effective immediately
		Unit	s

Tab. 184 Parameters - Following error

ID Dx.	Name	Description
07 | 02 | 00126 (117571710)	Position: following error	Position: following error
07 | 02 | 00127 (117571711)	Velocity: following error	Velocity: following error

Tab. 185 Diagnostic messages - Following error

Timing

Status signal	FE...
Initial state of FEX, FEV signals	= 0
The signal is set under the following conditions: – The difference (current actual value / continuously determined setpoint value) is outside the window – AND this condition is fulfilled for at least the specified time.	0→1
The signal is reset under the following conditions: – The difference (current actual value / continuously determined setpoint value) is within the window – OR the target has been reached (target reached = TRUE).	1→0

Tab. 186 Status signals - Following error

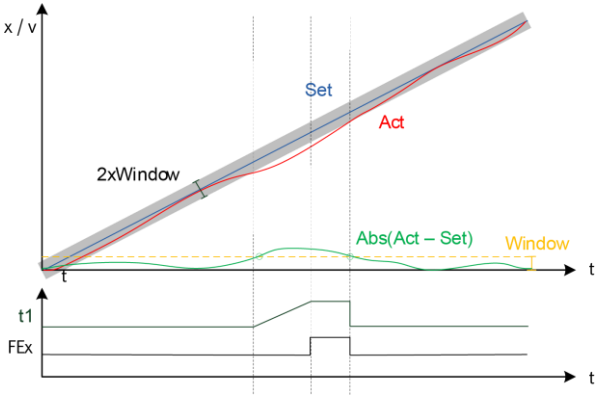


Fig. 44 Timing diagram: following error

Name	Description
x/v	Position and speed motion quantities
t1	Damping time
FEx	Diagnostic message
Window	Monitoring window
Act	Actual value
Set	Setpoint

Tab. 187 Legend for Timing diagram: following error

9.3.3.1 CiA 402

Objects - Following error

Parameters	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
462	0x6066.00	Damping time position: following error	UINT
463	0x6065.00	Monitoring window position: following error	UDINT
464	0x60F8.00	Monitoring window velocity: following error	DINT
4682	0x60F4.00	Current position: following error	DINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
462	0x2166.03	Damping time position: following error	UDINT
463	0x2166.04	Monitoring window position: following error	REAL
464	0x2166.05	Monitoring window velocity: following error	REAL
4682	0x2166.42	Current position: following error	REAL
4683	0x2166.43	Current velocity: following error	REAL
4690	0x2166.4A	Damping time velocity: following error	REAL

Tab. 188 Objects

9.3.3.2 PROFIdrive

PNUs of following error

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
462	11146.0	Damping time position: following error	FloatingPoint
463	11147.0	Monitoring window position: following error	FloatingPoint
464	11148.0	Monitoring window velocity: following error	FloatingPoint
4682	11624.0	Current position: following error	FloatingPoint
4683	11625.0	Current velocity: following error	FloatingPoint
4690	11632.0	Damping time velocity: following error	FloatingPoint

Tab. 189 PNUs

9.3.4 Target area monitoring

Target monitor TMx

The function monitors the movement of the HEPP gripper after reaching the target window (target reached = TRUE). Depending on the operating mode, the position, speed or torque are monitored during this process. The target area monitoring of a positioning command with a final speed is identical to the target area monitoring of a speed command.

Timing

Status signal	TM...
Initial state	= 0

Status signal	TM...
The signal is reset under the following conditions: – A new command is started – OR the difference (current actual value / target value) is outside the window.	1→0
The signal is set under the following conditions: – The associated target has been reached (target reached = TRUE) – OR the difference (current actual value / target value) is within the window AND this condition is fulfilled for at least the specified time.	0→1

Tab. 190 Status signals - Target area monitoring

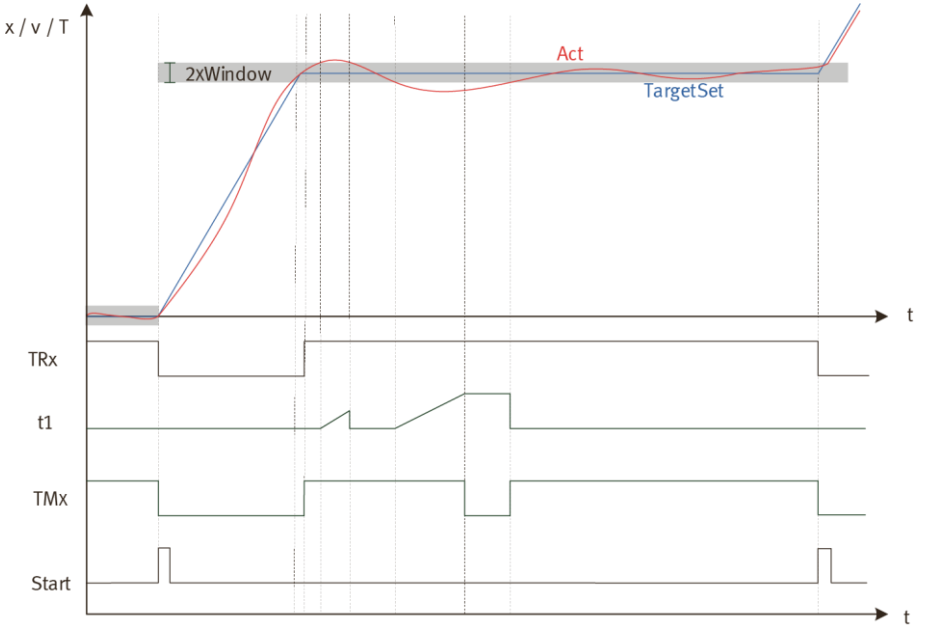


Fig. 45 Timing diagram: target area monitoring (example)

Name	Description
x/v/T	Position, speed and torque motion quantities
TRx	Target reached
t1	Damping time
TMx	Diagnostic message
Start	Start motion command
Window	Monitoring window
Act	Actual value
TargetSet	Target value

Tab. 191 Legend for Timing diagram: target area monitoring (example)

Parameters and diagnostic messages

ID Px.	Parameter	Description	
4665	Damping time target range	Specifies the damping time for target area monitoring (movement to a fixed stop). Minimum duration that the threshold value can be exceeded before a message is generated. The damping time is restarted if the actual value is below the threshold value or if the prefix for the specified setpoint value changes during the evaluation of the damping time.	
		Access	read/write
		Update	effective immediately
		Unit	s
4666	Monitoring window position	Determines the monitoring window for the target position. The monitoring window is set symmetrically to the target variable (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4667	Monitoring window velocity	Specifies the monitoring window for the target velocity. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4668	Monitoring window torque	Specifies the monitoring window for the target torque. The monitoring window is set symmetrically to the target value (window width = 2x parameter).	
		Access	read/write
		Update	effective immediately
		Unit	Nm

Tab. 192 Parameters - Target area monitoring

ID Dx.	Name	Description
07 | 02 | 00129 (117571713)	Out of target range	HEPP has left the target range

Tab. 193 Diagnostic messages - Target area monitoring

9.3.4.1 CiA 402

Objects - Target area monitoring

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
4665	0x2166.35	Damping time target range	REAL

Parameters	Index.Subindex	Name	Data type
4666	0x2166.36	Monitoring window position	REAL
4667	0x2166.37	Monitoring window velocity	REAL
4668	0x2166.38	Monitoring window torque	REAL

Tab. 194 Objects

9.3.4.2 PROFIdrive

PNUs of target area monitoring

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
4665	11611.0	Damping time target range	FloatingPoint
4666	11612.0	Monitoring window position	FloatingPoint
4667	11613.0	Monitoring window velocity	FloatingPoint
4668	11614.0	Monitoring window torque	FloatingPoint

Tab. 195 PNUs

9.3.5 Standstill monitoring

Standstill monitor STx

The monitoring function indicates that the HEPP gripper is not moving or that the HEPP gripper is only moving minimally at a speed that is lower than the parameterized threshold value. Despite a standstill message being set, the HEPP gripper can still move at a threshold value that is not equal to 0. Any drifting is prevented by additional position monitors.

Timing

Status signal	ST...
Position monitoring	**STX**
Initial state STX	= 0
The signal is set under the following conditions: – STV = 1 – AND the value (standstill position / actual position) is within the positioning window. The standstill position is the sampled actual position at the time of the rising edge of STV (0→1).	0→1
The STX signal is reset under the following conditions: – STV = 0 – OR the value (standstill position / actual position) is outside the positioning window.	1→0
Speed monitoring	**STV**
Initial state STV	= 0
The STV signal is set under the following conditions: – The actual speed value falls below the threshold value – AND the value falls below the threshold value for longer than the damping time.	0→1

Status signal	ST...
The STV signal is reset under the following condition: – The actual speed value exceeds the threshold value.	1→0

Tab. 196 Status signals - Standstill monitoring

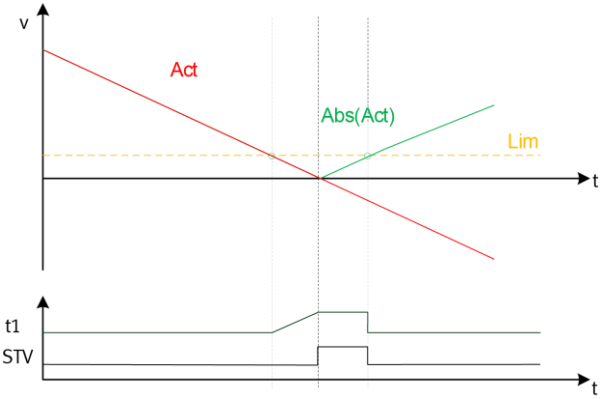


Fig. 46 Timing diagram: standstill monitoring

Name	Description
v	Speed motion quantity
t1	Damping time
STV	Diagnostic message
Act	Actual speed
Lim	Threshold value

Tab. 197 Legend for Timing diagram: standstill monitoring

Parameters and diagnostic messages

ID Px.	Parameters	Description	
465	Standstill damping time	Specifies the damping time of standstill monitoring. If the actual velocity value falls below the threshold value and if it exceeds the threshold during the damping time, the damping time is re-started once it falls below the threshold again.	
		Access	read/write
		Update	effective immediately
465	Standstill damping time	Unit	s
466	Monitoring window velocity standstill monitoring	Specifies the monitoring window for velocity standstill monitoring (maximum permissible velocity at a standstill). A standstill indicates that the actual velocity of the HEPP gripper is below the parameterized threshold value.	
		Access	read/write

ID Px.	Parameters	Description	
		Update	effective immediately
		Unit	user defined
467	Monitoring window position standstill	Specifies the monitoring window for position standstill monitoring to prevent drifting at a threshold value that is not equal to 0. The monitoring window is set symmetrically to the standstill position (window width = 2x parameter). The standstill position is determined by the positive edge of the STV signal.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

Tab. 198 Parameters - Standstill monitoring

ID Dx.	Name	Description
07 | 02 | 00124 (117571708)	Standstill reached	Standstill reached
07 | 02 | 00125 (117571709)	Standstill reached and in standstill window	Standstill reached and in standstill window

Tab. 199 Diagnostic messages - Standstill monitoring

9.3.5.1 CiA 402

Objects - Standstill monitoring

Parameters	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
465	0x6070.00	Standstill damping time	UINT
466	0x606F.00	Monitoring window velocity standstill monitoring	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
465	0x2166.06	Standstill damping time	REAL
466	0x2166.07	Monitoring window velocity standstill monitoring	REAL
467	0x2166.08	Monitoring window position standstill	REAL

Tab. 200 Objects

9.3.5.2 PROFIdrive

Standstill monitoring PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
465	11149.0	Standstill damping time	FloatingPoint
466	11150.0	Monitoring window velocity standstill monitoring	FloatingPoint
467	11151.0	Monitoring window position standstill	FloatingPoint

Tab. 201 PNUs

9.3.6 Stop reached

Limit stop LS

The monitoring function combines standstill monitoring (STV) and current monitoring for the stop detection. The actual current and velocity values are monitored cyclically to ensure that the defined limits are reached.

Timing

Status signal	LS
Stop detection	
Initial state LS	= 0
The LS signal is set under the following conditions: – The actual current value exceeds the threshold value – AND STV = 1 – AND both conditions are set to be longer than the damping time.	0→1
The LS signal is reset under the following conditions: – The actual current value falls below the threshold value. – OR STV = 0	1→0

Tab. 202 Status signals - Stop reached

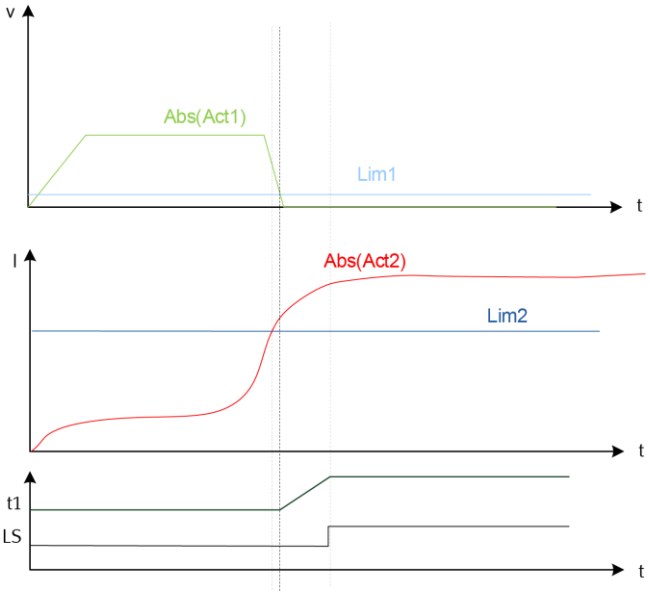


Fig. 47 Timing diagram: stop reached

Name	Description
v	Speed motion quantity

Name	Description
I	Active current
t1	Cushioning time
LS	Diagnostic message
Act1	Actual velocity
Act2	Actual active current
Lim1	STV
Lim2	Stop detection limit value

Tab. 203 Legend for Timing diagram: stop reached

Parameters and diagnostic messages

ID Px.	Parameter	Description	
4626	Stop detection limit value	Specifies the percentage threshold value for the current limit. The value is relative to the current parameterization of the nominal current.	
		Access	read/write
		Update	effective immediately
		Unit	–
4627	Damping time limit detection	Specifies the response delay when both conditions are met. If the current threshold is parameterized at more than 100%, the damping time must be set to lower than I^2t for the standstill (typically 50...200ms) to ensure that the detection is triggered. The damping time starts when both limit value monitors are valid. The damping time is reset if just one of the limit value monitors is invalid.	
		Access	read/write
		Update	effective immediately
		Unit	S

Tab. 204 Parameters - Stop reached

9.3.6.1 CiA 402

Objects - Stop reached

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
4626	0x2166.1B	Stop detection limit value	REAL
4627	0x2166.1C	Damping time limit detection	REAL

Tab. 205 Objects

9.3.6.2 PROFIdrive

Stop reached PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
4626	11581.0	Stop detection limit value	FloatingPoint
4627	11582.0	Damping time limit detection	FloatingPoint

Tab. 206 PNUs

9.3.7 Stroke limit reached

Stroke limit reached STL

The monitoring function includes:
- Status evaluation of the stroke limits
- Configuration check
- Monitoring of the completed, relative movement
- Automatic braking (optional)

In contrast to software limit position monitoring, stroke limit monitoring is only available for speed and power operation.

The stroke limit is activated and parameterized separately via the relevant command during direct or record operation ("Command with stroke limit monitoring"). Referencing is not necessary. The parameterized, relative monitoring window is applied to the current position when a new command is started. The stroke limit configuration is invalid if the negative stroke limit is greater or equal to the positive stroke limit.

Application

- Stroke limit monitoring without automatic braking:
  An error message is triggered if the stroke limit is reached or exceeded. The HEPP gripper is stopped with the parameterized error response. The error message can only be acknowledged once the stop ramp has expired.
- Stroke limit monitoring with automatic braking:
  Due to the current distance and speed, exceeding the stroke limit can be prevented by braking in time. The dynamic acceleration and jerk values from the stop ramp parameters are used for the projection.
  An error message is triggered, and the HEPP gripper is decelerated with the parameterized error response, so that it comes to a standstill before the stroke limit, if possible. The error message can only be acknowledged once the stop ramp has expired.

Timing

Status signal	STL...
Initial state of STLN/STLP signals	= 0
If stroke limit monitoring is activated for the command, the signal is set under the following conditions: – STLN: If the actual position is lower than the parameterized negative stroke limit – STLP: If the actual position is greater than the parameterized positive stroke limit – STLN/STLP, if automatic braking is triggered	0→1
The signal is reset when a new command is started.	1→0

Tab. 207 Status signals - Stroke limit reached

Parameters and diagnostic messages

ID Px.	Parameters	Description	
10368	Default value negative stroke limit	Specifies the negative stroke limit. The negative stroke limit must be lower than the positive stroke limit.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
10369	Default value positive stroke limit	Specifies the positive stroke limit. The positive stroke limit must be greater than the negative stroke limit.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
4675	Activation of automatic stop ramp stroke limit	Specifies whether automatic braking should be activated. If automatic braking is active, the HEPP gripper is decelerated so that it stops before the stroke limit, if possible. If automatic braking is deactivated, the HEPP gripper is only stopped once it reaches the stroke limit. 0: inactive 1: active	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 208 Parameters - Stroke limit reached

ID Dx.	Name	Description
07 | 01 | 00119 (117506167)	Negative stroke limit reached	Negative stroke limit reached
07 | 01 | 00120 (117506168)	Positive stroke limit reached	Positive stroke limit reached

Tab. 209 Diagnostic messages - Stroke limit reached

9.3.7.1 CiA 402

Objects - Stroke limit reached

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
10368	0x2190.08	Default value negative stroke limit	LINT
10369	0x2190.09	Default value positive stroke limit	LINT
4675	0x2166.3D	Activation of automatic stop ramp stroke limit	BOOL

Tab. 210 Objects

9.3.7.2 PROFIdrive

Stroke limit reached PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
10368	11819.0	Default value negative stroke limit	Integer64
10369	11820.0	Default value positive stroke limit	Integer64
4675	11619.0	Activation of automatic stop ramp stroke limit	Boolean

Tab. 211 PNUs

9.3.8 Speed monitoring (spinning protection)

Speed monitor VM

The monitoring function detects excessive speeds and prevents the HEPP gripper from spinning by stopping category 0. The function ensures that the parameterized speed threshold value is not exceeded.

Timing

Status signal	VM
Initial state VM	= 0
The signal is set under the following conditions: – The threshold value (speed) is reached	0→1
The signal is reset under the following conditions: – The value falls below the threshold value (speed)	1→0

Tab. 212 Status signals - Speed monitoring

Parameters and diagnostic messages

ID Px.	Parameters	Description	
4660	Maximum velocity	Specifies the absolute value of the maximum velocity. When the threshold value is reached, the HEPP gripper is stopped with stop category 0. A diagnostic message is issued if the parameterized velocity value is exceeded.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

Tab. 213 Parameters - Speed monitoring

ID Dx.	Name	Description
07 I 02 I 00128 (117571712)	Velocity too high	RPM monitoring reports velocity too high

Tab. 214 Diagnostic messages - Speed monitoring

9.3.8.1 CiA 402

Objects - Speed monitoring

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
4660	0x2166.30	Maximum velocity	REAL

Tab. 215 Objects

9.3.8.2 PROFIdrive

Velocity monitoring PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
4660	11606.0	Maximum velocity	FloatingPoint

Tab. 216 PNUs

9.3.9 Pushback monitoring

Pushback PB

The monitoring function checks the movement of the HEPP gripper as a function of the specified effective direction of the torque. The torque setpoint value may at most trigger an aligned movement. A reverse movement is only permissible below the parameterized velocity threshold value. If the torque setpoint value = 0, movements in both directions are only permitted below the parameterized threshold value.

Timing

Status signal	PB
Initial state	= 0
The signal is set under the following conditions: **Torque setpoint ≠ 0:** – The actual speed value exceeds the threshold value for longer than the damping time – AND the HEPP gripper moves in the opposite direction to the torque. **Torque setpoint = 0:** – The actual speed value exceeds the threshold value for longer than the damping time.	0→1
The signal is reset under the following conditions: – The setting logic is inverted.	1→0

Tab. 217 Status signals - Pushback monitoring

Parameters and diagnostic messages

ID Px.	Parameters	Description	
4663	Monitoring window pushback	Specifies the monitoring window for pushback monitoring. Threshold value for monitoring the actual velocity (direction of movement) in relation to the effective direction of the torque (setpoint value).	
		Access	read/write
		Update	effective immediately

ID Px.	Parameters	Description	
		Unit	user defined
4664	Damping time push-back	Specifies the damping time for pushback monitoring. Minimum duration that the threshold value can be exceeded before a message is generated. The damping time is restarted if the actual velocity is below the threshold value or if the prefix for the specified setpoint value (torque) changes during the evaluation of the damping time.	
		Access	read/write
		Update	effective immediately
		Unit	s

Tab. 218 Parameters - Pushback monitoring

ID Dx.	Name	Description
07 I 02 I 00130 (117571714)	Reverse feed monitoring	Reverse feed monitoring reports error

Tab. 219 Diagnostic messages - Pushback monitoring

9.3.9.1 CiA 402

Objects - Pushback monitoring

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
4663	0x2166.33	Monitoring window pushback	REAL
4664	0x2166.34	Damping time pushback	REAL

Tab. 220 Objects

9.3.9.2 PROFIdrive

Pushback monitoring PNUs

Parameters	PNU	Name	Data type
Px.	Manufacturer-specific parameters		
4663	11609.0	Monitoring window pushback	FloatingPoint
4664	11610.0	Damping time pushback	FloatingPoint

Tab. 221 PNUs

9.3.10 Remaining distance monitoring

Remain distance monitor RDX

The monitoring function indicates that the remaining path determined during the ongoing positioning command is below the specified limit value.

Timing

Status signal	RD...
Initial state	= 0
The RD signal is set under the following condition: – The difference (command target value / current actual value) falls below the limit value.	0→1
The RD signal is reset under the following condition: – The setting logic is inverted.	1→0

Tab. 222 Status signals - Remaining distance monitoring

Parameters and diagnostic messages

ID Px.	Parameters	Description	
4685	Limit value remaining distance monitoring	Specifies the limit value of the remaining distance to be monitored.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

Tab. 223 Parameters - Remaining distance monitoring

ID Dx.	Name	Description
07 I 02 I 00131 (117571715)	Residual distance too low	Residual distance too low

Tab. 224 Diagnostic messages - Remaining distance monitoring

9.3.10.1 CiA 402

Objects - Remaining distance monitoring

Parameters	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
4685	0x2166.69	Limit value remaining distance monitoring	SINT64

Tab. 225 Objects

9.3.10.2 PROFIdrive

Remaining distance monitoring PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
4685	11627.0	Limit value remaining distance monitoring	Integer64

Tab. 226 PNUs

9.3.11 Trajectory completed

Motion complete MC

The monitoring function indicates that a trajectory (movement) has been completed.

Timing

Status signal	MC
Initial state	= 0
The signal is set under the following conditions: – The trajectory is completed.	0→1
The signal is reset under the following conditions: – A new command is started.	1→0

Tab. 227 Status signals - Trajectory completed

Parameters and diagnostic messages

ID Dx.	Name	Description
07 I 02 I 00132 (117571716)	Trajectory completed	Trajectory completed (setpoint value reached)

Tab. 228 Diagnostic messages - Trajectory completed

9.4 Control

9.4.1 Cascade controller

9.4.1.1 Function

The movement of the HEPP gripper is regulated by the cascade control. The basic structure of the cascade controller consists of a position controller, a velocity controller and a current regulator. The active control loop of the cascade control depends on the selected operating mode. The input variables of the individual control loops are controlled to the setpoints. The actual values are formed from the encoder data and the measured current. Improved control behavior can be implemented with a pilot control. Limitations for the current and velocity controllers can also be activated. Aside from the active control parameter set, 3 additional control parameter sets are available for parameterization of the cascade controller.

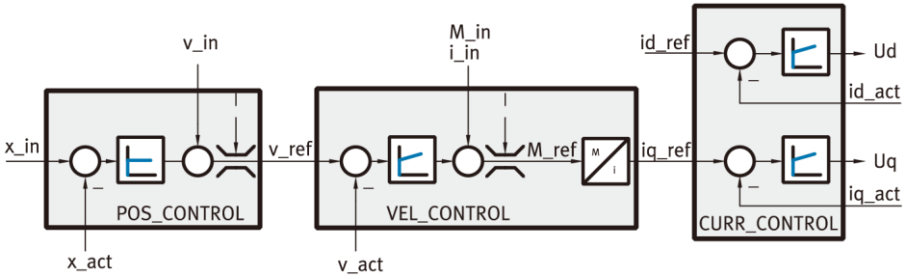


Fig. 48 Block diagram of cascade controller

Name	Parameter	ID Px.
i_in	Feed forward control current output The current value is used as a pilot control value for the current regulator. The resulting setpoint value is dependent on the parameterized upstream variables of the pilot control ➔ 9.4.3 Pilot control (closed-loop control setpoint values). The relationship i_in = M_in/(torque constant x gear unit factor) is between i_in and M_in.	95
id_act	Actual reactive current value	813
id_ref	Setpoint value reactive current	87
iq_act	Actual active current value	814
iq_ref	Setpoint value active current	86
M_in	Setpoint value torque The torque setpoint value is used as a pilot control value for the current regulator and refers to the output side (motor + gear unit). The resulting setpoint value is dependent on the parameterized upstream variables of the pilot control ➔ 9.4.3 Pilot control (closed-loop control setpoint values).	94
M_refM_r- ef	Setpoint value torque	2220
v_act	Actual velocity value	1210
v_in	Setpoint value velocity The velocity setpoint value is used as a pilot control value for the velocity regulator ➔ 9.4.3 Pilot control (closed-loop control setpoint values).	91
v_ref	Setpoint value velocity controller	2216
x_act	Actual position value	128
x_in	Setpoint value position	90

Tab. 229 Legend for the block diagram of the cascade controller

9.4.1.2 Position controller

The position controller is designed as P-closed-loop controller that calculates the velocity specification for the secondary velocity control circuit from the control difference (setpoint position - actual position). A dead zone element suppresses all control differences with the value "0" if it lies within the parameterized symmetrical dead zone. The P-element generates the setpoint velocity from the control difference and position controller amplification factor. This can be asymmetrically limited via the minimum and maximum correction velocity. At active velocity pilot control (default setting), values "Setpoint velocity" and "Velocity pilot control" are added and issued as velocity specification to the secondary velocity controller. The velocity controller setpoint value can be asymmetrically limited via the resulting lower and upper limit value velocity. If the setpoint value reaches the limit, it can be queried via a status.

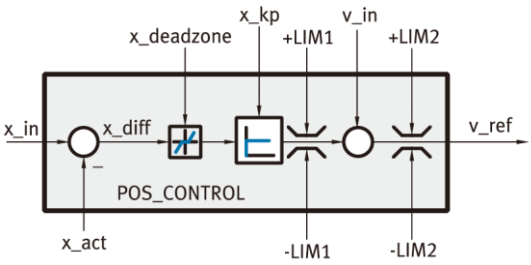


Fig. 49 Block diagram of position controller

Name	Parameter	ID Px.
x_act	Actual position value	128
x_deadzone	Dead zone position controller	221
x_diff	Position control error	2217
x_in	Setpoint value position	90
x_kp	Position controller amplification gain	220
v_in	Setpoint value velocity The velocity setpoint value is used as a pilot control value for the velocity regulator ➔ 9.4.3 Pilot control (closed-loop control setpoint values).	91
v_ref	Setpoint value velocity controller	2216
–LIM1	Minimum correction velocity	222
+LIM1	Maximum correction velocity	223
–LIM2	Resulting lower limit value velocity (closed loop controller) This limit value is an output value of the limiter for the setpoint velocity➔ Fig. 53	6100
+LIM2	Resulting upper limit value velocity (closed loop controller) This limit value is an output value of the limiter for the setpoint velocity➔ Fig. 53	6101

Tab. 230 Legend for the block diagram of the position controller

Parameters and diagnostic messages

ID Px.	Parameter	Description	
220	Position controller amplification gain	Specifies the amplification gain for the P-element in the position controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
221	Dead zone position controller	Specifies the value (relative to the zero point) of the dead zone in the position controller. If the control deviation value is in the range of the dead zone, the value "0" is output on the output of the element.	

ID Px.	Parameter	Description	
		Access	read/write
		Update	effective immediately
		Unit	user defined
222	Minimum correction velocity	Specifies the limit value "Minimum correction velocity" for the velocity limitation on the output of the P-element in the position controller.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
223	Maximum correction velocity	Specifies the limit value "Maximum correction velocity" for the velocity limitation on the output of the P-element in the position controller.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
2216	Setpoint value velocity controller	Specifies the setpoint velocity for the velocity controller at the output of the position controller including the feed forward control value for the velocity.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
2217	Position control error	Specifies the control difference of input variables "Feed forward control output position" and "Actual position" on the output of the setpoint-actual comparator in the position controller.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
6100	Resulting lower limit value velocity (closed loop controller)	Specifies the limit value "Lower limit value of velocity" for velocity limiting.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
6101	Resulting upper limit value velocity (closed loop controller)	Specifies the limit value "Upper limit value of velocity" for velocity limiting.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
52675	Velocity limiting active	Specifies the monitoring status of "Velocity limiting is active" for the setpoint value for the velocity controller in the position controller.	
		Access	read/–

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
526794	Filter time constant controller limitation	Specifies the filter time constant for reaching a limit in the velocity or current control circuit	
		Access	read/write
		Update	effective immediately
		Unit	s

Tab. 231 Parameter

ID Dx.	Name	Description
07 I 03 I 00135 (117637255)	Limit for velocity or current active	A limit for the velocity or current is active

Tab. 232 Diagnostic messages

9.4.1.2.1 CiA 402

Position controller PNUs

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
220	0x215B.01	Position controller amplification gain	REAL
221	0x215B.02	Dead zone position controller	LINT
222	0x215B.03	Minimum correction velocity	REAL
223	0x215B.04	Maximum correction velocity	REAL
2216	0x215B.08	Setpoint value velocity controller	REAL
2217	0x215B.09	Position control error	LINT
6100	0x2168.08	Resulting lower limit value velocity (closed loop controller)	REAL
6101	0x2168.09	Resulting upper limit value velocity (closed loop controller)	REAL
52675	0x2152.09	Velocity limiting active	BOOL
526794	0x2152.0D	Filter time constant controller limitation	REAL

Tab. 233 Objects

9.4.1.2.2 PROFIdrive

Position controller PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
220	11080.0	Position controller amplification gain	FloatingPoint
221	11081.0	Dead zone position controller	Integer64

Parameters	PNU	Name	Data type
222	11082.0	Minimum correction velocity	FloatingPoint
223	11083.0	Maximum correction velocity	FloatingPoint
2216	11412.0	Setpoint value velocity controller	FloatingPoint
2217	11413.0	Position control error	Integer64
6100	11640.0	Resulting lower limit value velocity (closed loop controller)	FloatingPoint
6101	11641.0	Resulting upper limit value velocity (closed loop controller)	FloatingPoint
52675	11889.0	Velocity limiting active	Boolean
526794	12165.0	Filter time constant controller limitation	FloatingPoint

Tab. 234 PNUs

9.4.1.3 Velocity controller

The velocity controller is designed as a PI closed-loop controller (with anti-windup function) which calculates the torque specifications for the secondary current control circuit from the control difference (setpoint velocity - actual velocity). At active torque pilot control (default setting) the "Setpoint torque" and "Torque pilot control" values are added and output to the secondary current regulator as torque specification. The torque setpoint value can be asymmetrically limited via the minimum and maximum torque. A torque current converter converts the torque setpoint value into an active current setpoint value by means of the torque constant and the gear unit factor. If the setpoint value reaches the limit, this can be requested via a status. For use with the Ci402 protocol, the torque setpoint value is asymmetrically limited by a further limitation.

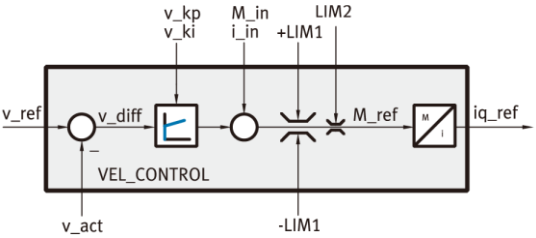


Fig. 50 Block diagram of velocity controller

Name	Parameter	ID Px.
i_in	Feed forward control current output The current value is used as a pilot control value for the current regulator. The resulting setpoint value is dependent on the parameterized upstream variables of the pilot control ➔ 9.4.3 Pilot control (closed-loop control setpoint values). Between i_in and M_in, there is the relationship i_in = M_in/(torque constant x gear unit factor).	95
iq_ref	Setpoint value active current	86

Name	Parameter	ID Px.
M_in	Setpoint value torque The setpoint value torque is used as a pilot control value for the velocity regulator. The resulting setpoint value is dependent on the parameterized upstream variables of the pilot control ➔ 9.4.3 Pilot control (closed-loop control setpoint values).	94
M_refM_ref	Setpoint value torque	2220
v_kp	Velocity controller amplification gain	224
v_ki	Velocity controller integration constant	225
v_act	Actual velocity value	1210
v_diff	Velocity control error	2215
v_ref	Setpoint value velocity controller	2216
–LIM1	Minimum torque This limit value is an output value of the limiter for the torque ➔ 9.4.2.3 Torque limitation.	2218
+LIM1	Maximum torque This limit value is an output value of the limiter for the torque ➔ 9.4.2.3 Torque limitation.	2219
LIM2	Maximum torque symmetrical	526796

Tab. 235 Legend for the block diagram of the velocity controller

Recommendation: before changing controller parameters, check the signal of the encoder. If required, optimize signal noises using a suitable filter time constant.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
224	Velocity controller amplification gain	Specifies the amplification gain for the PI-element in the velocity controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
225	Velocity controller integration constant	Specifies the integration constant for the PI-element in the velocity controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
1210	Actual velocity value	Specifies the velocity measured by the integrated encoder.	
		Access	read/–
		Update	effective immediately
		Unit	user defined

ID Px.	Parameter	Description	
2215	Velocity control error	Specifies the control difference of input variables "Velocity controller setpoint value" and "Actual value of velocity transducer interface 1" on the output of the setpoint-actual comparator in the velocity controller.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
2216	Setpoint value velocity controller	Specifies the setpoint velocity for the velocity controller at the output of the position controller including the feed forward control value for the velocity.	
		Access	read/–
2216	Setpoint value velocity controller	Update	effective immediately
		Unit	user defined
2218	Minimum torque	Specifies the minimum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
2219	Maximum torque	Specifies the maximum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
2220	Setpoint value torque	Specifies the torque setpoint for the current controller in the velocity controller.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
52676	Current limitation active	Specifies the monitoring status of "Current limiting is active" for the setpoint value of the active current in the velocity controller.	
		Access	read/–
		Update	effective immediately
		Unit	–
526796	Maximum torque symmetrical	Specifies the limit value "maximum torque" for the symmetrical torque limitation at the output of the velocity controller.	
		Access	read/write
		Update	effective immediately
		Unit	Nm

Tab. 236 Parameter

ID Dx.	Name	Description
06 | 02 | 00086 (100794454)	Sign limits	The target torque and the velocity limit are uncorrelated.

Tab. 237 Diagnostic messages

9.4.1.3.1 CiA 402

Velocity controller objects

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
1210	0x606C.00	Actual velocity value	DINT
526796	0x6072.00	Maximum torque symmetrical	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
224	0x215B.05	Velocity controller amplification gain	REAL
225	0x215B.06	Velocity controller integration constant	REAL
1210	0x2155.0B	Actual velocity value	REAL
2215	0x215B.07	Velocity control error	REAL
2216	0x215B.08	Setpoint value velocity controller	REAL
2218	0x215B.0A	Minimum torque	REAL
2219	0x215B.0B	Maximum torque	REAL
2220	0x215B.0C	Setpoint value torque	REAL
52676	0x2152.0A	Current limitation active	BOOL
526796	0x2168.17	Maximum torque symmetrical	REAL

Tab. 238 Objects

9.4.1.3.2 PROFIdrive

Velocity controller PNUs

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		
1210	6.0	Actual velocity value	Integer16
Px.	**Manufacturer-specific parameters**		
224	11084.0	Velocity controller amplification gain	FloatingPoint
225	11085.0	Velocity controller integration constant	FloatingPoint
1210	11311.0	Actual velocity value	FloatingPoint
2215	11411.0	Velocity control error	FloatingPoint
2216	11412.0	Setpoint value velocity controller	FloatingPoint
2218	11414.0	Minimum torque	FloatingPoint
2219	11415.0	Maximum torque	FloatingPoint
2220	11416.0	Setpoint value torque	FloatingPoint

Parameter	PNU	Name	Data type
52676	11890.0	Current limitation active	Boolean
526796	12166.0	Maximum torque symmetrical	FloatingPoint

Tab. 239 PNUs

9.4.1.4 Current regulator

The current regulator consists of an active current regulator and a reactive current regulator which specify the voltage setpoint values for the secondary power output stages.

Active current regulator:

The active current regulator is designed as a PI controller (with anti-windup functions), which uses the control difference (Setpoint value active current – Actual active current value) to calculate the voltage specification Uq_ref for the secondary voltage transformation.

Reactive current regulator:

The reactive current regulator is designed as a PI regulator (with anti-windup functionality), which calculates the voltage specification Ud_ref for the subordinate voltage transformation from the control difference (Setpoint value reactive current - actual reactive current value).

Voltage limitation:

The voltages Uq_ref and Ud_ref are evaluated jointly. The voltage phasor calculated from Uq_ref and Ud_ref is limited to the maximum output voltage. The status of the respective limitation for Uq_ref and Ud_ref can be requested.

Voltage transformation:

The voltage transformation generates the setpoint value specifications for the secondary power output stage from input variables "Voltage setpoint value". This prioritizes the voltage Ud as default against voltage Uq.

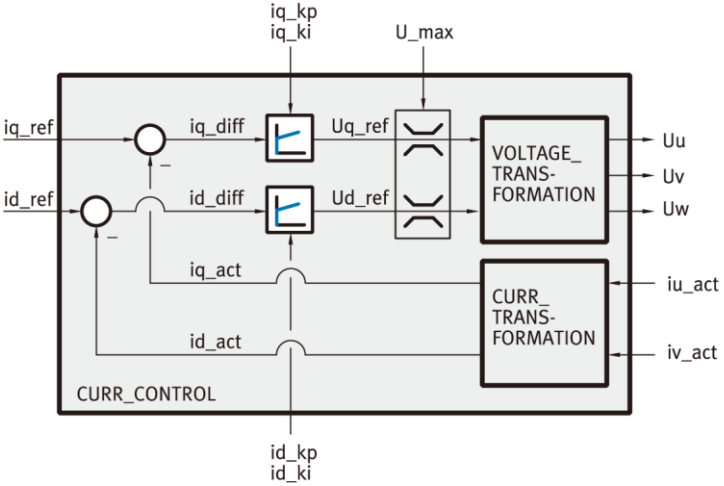


Fig. 51 Block diagram of current regulator

Name	Parameter	ID Px.
id_act	Actual reactive current value	813
id_diff	Reactive current control error	824
id_ki	Integration constant current controller (reactive current)	81
id_kp	Amplification gain current controller (reactive current)	80
id_ref	Setpoint value reactive current	87
iq_act	Actual active current value	814
iq_diff	Active current control error	825
iq_ki	Integration constant current controller (active current)	83
iq_kp	Amplification gain current controller (active current)	82
iq_ref	Setpoint value active current	86
iu_act	Actual phase U current value	39
iv_act	Actual phase V current value	310
Ud_ref	Setpoint value voltage Ud	84
Uq_ref	Setpoint value voltage Uq	85
U_max	Maximum output voltage	88
Uu	Setpoint value of motor voltage phase U	–
Uv	Setpoint value of motor voltage phase V	–
Uw	Setpoint value of motor voltage phase W	–

Tab. 240 Legend for the block diagram of the current regulator

Parameters and diagnostic messages

ID Px.	Parameter	Description	
39	Actual phase U current value	Specifies the actual value of the phase U current.	
		Access	read/–
		Update	effective immediately
		Unit	A
80	Amplification gain current controller (reactive current)	Specifies the amplification gain for the P-element in the reactive current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
81	Integration constant current controller (reactive current)	Specifies the integration constant for the I-element in the reactive current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
82	Amplification gain current controller (active current)	Specifies the amplification gain for the P-element in the effective current controller.	
		Access	read/write

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
83	Integration constant current controller (active current)	Specifies the integration constant for the I-element in the effective current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
84	Setpoint value voltage Ud	Specifies the setpoint voltage Ud at the output of the reactive current controller.	
		Access	read/–
		Update	effective immediately
		Unit	V
85	Setpoint value voltage Uq	Specifies the setpoint voltage Uq at the output of the active current controller.	
		Access	read/–
		Update	effective immediately
		Unit	V
86	Setpoint value active current	Specifies the active current setpoint for the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
87	Setpoint value reactive current	Specifies the reactive current setpoint for the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
88	Maximum output voltage	Specifies the limit value "Maximum output voltage" for the outputs of the PI-elements (reactive current/active current) in the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	V
310	Actual phase V current value	Specifies the actual value of the phase V current.	
		Access	read/–
		Update	effective immediately
		Unit	A
813	Actual reactive current value	Specifies the actual reactive current at the output of the current transformation.	
		Access	read/–

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	Arms
814	Actual active current value	Specifies the actual active current at the output of the current transformation.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
824	Reactive current control error	Specifies the control difference of input variables "Reactive current setpoint value" and "Actual value of reactive current" on the output of the setpoint-actual comparator in the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
825	Active current control error	Specifies the control difference of input variables "Active current setpoint value" and "Actual value of active current" on the output of the setpoint-actual comparator in the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
1206	Length motor cable	Determines the length of the HEPP motor cable. The length of the HEPP motor cable is required for controller sizing.	
		Access	read/write
		Update	effective immediately
		Unit	mCable
1208	Cable cross section	Defines the cable cross-section in mm². The cable cross-section is required for controller sizing.	
		Access	read/write
		Update	effective immediately
		Unit	mm²
52679	Voltage limiting filter time constant	Specifies the filter time constant for reaching the voltage limit.	
		Access	read/write
		Update	effective immediately
		Unit	s
52680	Voltage limiting Ud active	Specifies the monitoring status of "Voltage limiting Ud active" for the voltage Ud setpoint value in the current controller.	
		Access	read/–
		Update	effective immediately

ID Px.	Parameter	Description	
		Unit	–
52681	Voltage limiting Uq active	Specifies the monitoring status of "Voltage limiting Uq active" for the voltage Uq setpoint value in the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 241 Parameter

ID Dx.	Name	Description
07 I 03 I 00134 (117637254)	Voltage limiting active	Voltage limiting active

Tab. 242 Diagnostic messages

9.4.1.4.1 CiA 402

Current regulator objects

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
814	0x6078.00	Actual active current value	INT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
39	0x2151.0A	Actual phase U current value	REAL
80	0x2153.01	Amplification gain current controller (reactive current)	REAL
81	0x2153.02	Integration constant current controller (reactive current)	REAL
82	0x2153.03	Amplification gain current controller (active current)	REAL
83	0x2153.04	Integration constant current controller (active current)	REAL
84	0x2153.05	Setpoint value voltage Ud	REAL
85	0x2153.06	Setpoint value voltage Uq	REAL
86	0x2153.07	Setpoint value active current	REAL
87	0x2153.08	Setpoint value reactive current	REAL
88	0x2153.09	Maximum output voltage	REAL
310	0x2151.0B	Actual phase V current value	REAL
813	0x2153.0E	Actual reactive current value	REAL
814	0x2153.0F	Actual active current value	REAL
819	0x2153.14	Control parameter equalization for active and reactive current controllers	BOOL
824	0x2153.15	Reactive current control error	REAL

Parameter	Index.Subindex	Name	Data type
825	0x2153.16	Active current control error	REAL
1206	0x217F.07	Length motor cable	REAL
1208	0x217F.09	Cable cross section	REAL
52679	0x2151.0C	Voltage limiting filter time constant	REAL
52680	0x2151.0D	Voltage limiting Ud active	BOOL
52681	0x2151.0E	Voltage limiting Uq active	BOOL

Tab. 243 Objects

9.4.1.4.2 PROFIdrive Current regulator PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
39	11021.0	Actual phase U current value	FloatingPoint
80	11035.0	Amplification gain current controller (reactive current)	FloatingPoint
81	11036.0	Integration constant current controller (reactive current)	FloatingPoint
82	11037.0	Amplification gain current controller (active current)	FloatingPoint
83	11038.0	Integration constant current controller (active current)	FloatingPoint
84	11039.0	Setpoint value voltage Ud	FloatingPoint
85	11040.0	Setpoint value voltage Uq	FloatingPoint
86	11041.0	Setpoint value active current	FloatingPoint
87	11042.0	Setpoint value reactive current	FloatingPoint
88	11043.0	Maximum output voltage	FloatingPoint
310	11113.0	Actual phase V current value	FloatingPoint
813	11189.0	Actual reactive current value	FloatingPoint
814	11190.0	Actual active current value	FloatingPoint
819	11195.0	Control parameter equalization for active and reactive current controllers	Boolean
824	11200.0	Reactive current control error	FloatingPoint
825	11201.0	Active current control error	FloatingPoint
1206	11308.0	Length motor cable	FloatingPoint
1208	11310.0	Cable cross section	FloatingPoint
52679	11893.0	Voltage limiting filter time constant	FloatingPoint
52680	11894.0	Voltage limiting Ud active	Boolean
52681	11895.0	Voltage limiting Uq active	Boolean

Tab. 244 PNUs

9.4.1.5 Control parameter sets

Aside from the active control parameter set, 3 additional control parameter sets are available for the parameterization of the cascade controller. A control parameter set contains all control parameters for position and velocity controllers and current regulators, the total inertia for the torque pilot control and the filter time constant for the actual velocity value filter. When a control parameter set is changed, the total inertia and the velocity filter are also changed.
The individual control parameter sets can be activated via the record table or the device profile. The switch over duration into another control parameter set can be influenced by the transition time. There is a linear interpolation of all values during the switch over.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
44	Change close loop parameter set status	Specifies the status of the activated close loop parameter set in the change close loop parameter set.	
		Access	read/–
		Update	effective immediately
		Unit	–
226	Amplification gain position controller	Specifies the amplification gain in the parameter sets for the P- element in the position controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
2210	Velocity controller amplification gain	Specifies the amplification gain in the parameter sets for the PI- element in the velocity controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
2211	Velocity controller integration constant	Specifies the integration constant in the parameter sets for the PI-element in the velocity controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
2223	Amplification gain current controller (active current)	Specifies the amplification gain "Active current" in the parameter sets for the PI-element in the current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
2224	Integration constant current controller (active current)	Specifies the integration constant "Active current" in the parameter sets for the PI-element in the current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
2225	Amplification gain current controller (reactive current)	Specifies the amplification gain "Reactive current" in the parameter sets for the PI-element in the current controller.	
		Access	read/write
		Update	effective immediately
		Unit	–
2227	Total inertia	Specifies the total inertia torque of the HEPP gripper drive train (axis, gear unit, motor, load). A value input by the user is overwritten with the total of all inertias from the configured HEPP gripper drive train, including the load, by calculation of the control parameters.	
		Access	read/write
		Update	effective immediately
		Unit	kgm²
2228	Velocity filter filter time constant	Specifies the filter time constant for the actual velocity value filter for the parameter sets.	
		Access	read/write
		Update	effective immediately
		Unit	s

Tab. 245 Parameter

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.4.1.5.1 CiA 402

Control parameter sets objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
44	0x2156.01	Change close loop parameter set status	BOOL
226	0x2227.01 ... 03	Amplification gain position controller	REAL
2210	0x2228.01 ... 03	Velocity controller amplification gain	REAL
2211	0x2229.01 ... 03	Velocity controller integration constant	REAL
2223	0x222A.01 ... 03	Amplification gain current controller (active current)	REAL
2224	0x222B.01 ... 03	Integration constant current controller (active current)	REAL
2225	0x222C.01 ... 03	Amplification gain current controller (reactive current)	REAL
2227	0x222E.01 ... 03	Total inertia	REAL
2228	0x222F.01 ... 03	Velocity filter filter time constant	REAL

Tab. 246 Objects

Controlling the controller parameter set switchover

Object 0x2001.01: starting the controller parameter set switchover

The start of the controller parameter set switchover is controlled via the object:

Bit[1)]	Description
0→1	Controller parameter set switchover started on parameterized

1) signal status: 0→1 = rising edge

Tab. 247 Starting the controller parameter set switchover

Monitoring controller parameter set switchover

Object 0x2001.02: status of the controller parameter set switchover

The status of the controller parameter set switchover is issued via the object:

Bit[1)]	Description
0	Controller parameter set switchover not active
1	Controller parameter set switchover active

1) Signal status: 0 = low; 1 = high

Tab. 248 Status of the controller parameter set switchover

Object 0x2001.05: return value of device access

The status of the device access is issued via the object:

Bit[1)]	Description
0	Device access successful
1	Device access was aborted with an internal error

1) Signal status: 0 = low; 1 = high

Tab. 249 Return value of device access

9.4.1.5.2 PROFIdrive

Control parameter sets PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
44	11026.0	Change close loop parameter set status	Boolean
226	11086.0 ... 2	Amplification gain position controller	FloatingPoint
2210	11409.0 ... 2	Velocity controller amplification gain	FloatingPoint
2211	11410.0 ... 2	Velocity controller integration constant	FloatingPoint
2223	11419.0 ... 2	Amplification gain current controller (active current)	FloatingPoint
2224	11420.0 ... 2	Integration constant current controller (active current)	FloatingPoint
2225	11421.0 ... 2	Amplification gain current controller (reactive current)	FloatingPoint
2227	11423.0 ... 2	Total inertia	FloatingPoint
2228	11424.0 ... 2	Velocity filter filter time constant	FloatingPoint

Tab. 250 PNUs

9.4.2 Limitation

9.4.2.1 Application limitations

The setpoint specifications for the trajectory generator are limited by the application limitations, which are specified by the active record table, profile operating mode (positioning, velocity or force/torque), jogging or homing.
During the test, the variables of movement "velocity (v), acceleration (a), deceleration (d) and torque (M)" are compared with the specified limitations (jerk is not limited). If all setpoint values lie within the specified limitations, the trajectory generator calculates the path course for the specified setpoint values. If the setpoint values lie outside the limitations, the setpoint values are limited to the specific value and a corrected trajectory is calculated.
The motion variables can be asymmetrically limited via the minimum and maximum. If a position order is executed with final velocity, the final velocity is also limited. If one of the setpoint values reaches the limit, it can be requested via a status.
The parameter velocity override Px.1309 can be used to influence the parameterized target velocity in the range of 0 ... 200%. The value for the velocity override can be selected in the range from 0 ... 2. The scaling for 100% corresponds to the value 1. The setting affects the following motion types:
– Positioning records
– Jogging
– Homing
– Target value specification

For devices with the PROFIdrive drive profile, the velocity override is set in the range from 0 ... 200 via parameter Px.11280611. The standardization for 100% corresponds to the value 0x4000 ➔ Velocity Override (OVERRIDE).

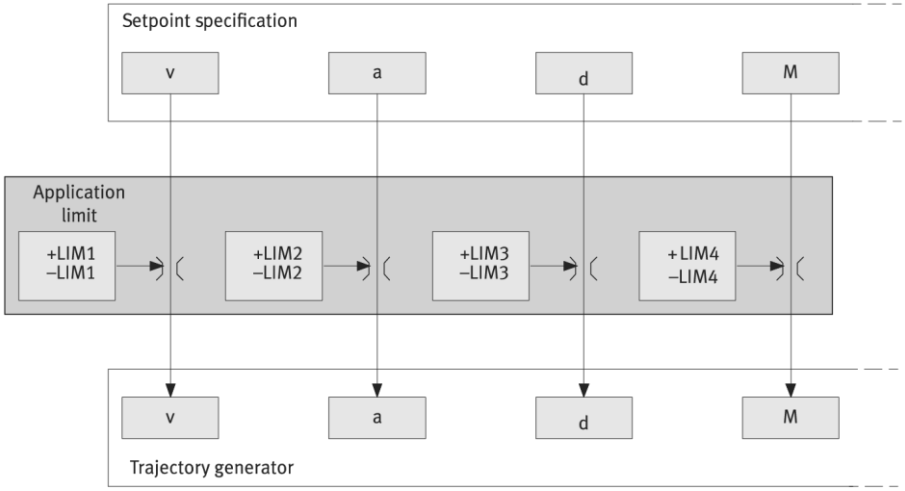


Fig. 52 Structure of the application limit

Name	Parameter	ID Px.
+LIM1	Limit value velocity limit positive direction of movement	1304
–LIM1	Limit value velocity limit negative direction of movement	1310
+LIM2	Upper limit value acceleration limitation	1305
–LIM2	Lower limit value acceleration limitation	1311
+LIM3	Upper limit value deceleration limitation	1306
–LIM3	Lower limit value deceleration limit	1312
+LIM4	Upper limit torque limitation	1307
–LIM4	Lower limit torque limitation	1308

Tab. 251 Legend of the block diagram for the application limitation

Limit values of the velocity limiting (+LIM1/–LIM1):
- The limiting is effective for all position, velocity and torque commands (PP, PV, PT mode). The limit also applies to all orders that e.g. are part of homing, jogging or zero-angle detection.
- The positive value must be ≥ 0 and applies to all movements in the positive direction.
- The negative value must be ≤ 0 and applies to all movements in the negative direction. Limit values of the acceleration limitation (+LIM2/–LIM2)
- The limitation is effective for all position and velocity commands (PP, PV mode). The limit also applies to all orders that e.g. are part of homing, jogging or zero-angle detection.
- The maximum and minimum value must be ≥ 0.
- The maximum value must be greater than the minimum values.
- The violation of the condition is not checked until the limit values are actively used. In the event of an error, the limitation is ineffective and a diagnostic message is triggered. Limit values of the deceleration limitation (+LIM3/–LIM3):
- The limitation is effective for all position and velocity commands (PP, PV mode). The limit also applies to all orders that e.g. are part of homing, jogging or zero-angle detection.
- The maximum and minimum value must be greater than = 0.
- The maximum value must be greater than the minimum value.
- The violation of the condition is not checked until the limit values are actively used. In the event of an error, the limitation is ineffective and a diagnostic message is triggered. Limit values of the torque limitation (+LIM4/–LIM4):
- The limitation is only effective for torque commands (PT mode). The limit also applies to all orders that e.g. are part of homing, jogging or zero-angle detection.
- The positive value must be ≥ 0 and applies to all movements in the positive direction.
- The negative value must be ≤ 0 and applies to all movements in the negative direction.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
1301	Velocity limiting status	Indicates the status of the velocity limitation for the application limitation.	
		Access	read/–
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
1302	Acceleration limiting status	Specifies the status of the acceleration limitation for the application limitation.	
		Access	read/–
		Update	effective immediately
		Unit	–
1303	Torque limiting status	Specifies the status of the torque limitation for the application limitation.	
		Access	read/–
		Update	effective immediately
		Unit	–
1304	Limit value velocity limit positive direction of movement	Specifies the velocity limit value for the positive direction of movement in the application limitation.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1305	Upper limit value acceleration limitation	Specifies the upper limit value for the acceleration limitation in the application limitation. The limitation must be greater than 0 and greater than Px.1311.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1306	Upper limit value deceleration limitation	Specifies the upper limit value for the deceleration limitation in the application limitation. The limitation must be greater than 0 and greater than Px.1312.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1307	Upper limit torque limitation	Specifies the upper limit value for the torque limitation in the application limitation.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
1308	Lower limit torque limitation	Specifies the lower limit value for the torque limitation in the application limitation.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
1309	Velocity override	Specifies the velocity override in positioning and velocity mode. The override can be set in the range from 0...2. The normalization for 100 % corresponds to the value of 1.	
		Access	read/write

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
1310	Limit value velocity limit negative direction of movement	Specifies the velocity limit value for the negative direction of movement in the application limitation.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1311	Lower limit value acceleration limitation	Specifies the lower limit value for the acceleration limitation in the application limitation. The limitation must be greater than 0 and less than Px.1305.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1312	Lower limit value deceleration limit	Specifies the lower limit value for the deceleration limitation in the application limitation. The limitation must be greater than 0 and less than Px.1306.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
11280611	Velocity override	Specifies the velocity override in positioning and velocity mode. The override can be set in the range 0 ... 200 %. The scaling for 100 % corresponds to the value of 0x4000.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 252 Parameter

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.4.2.1.1 CiA 402

Application limitation objects

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
1304	0x607F.00	Limit value velocity limit positive direction of movement	UDINT
1305	0x60C5.00	Upper limit value acceleration limitation	UDINT
1306	0x60C6.00	Upper limit value deceleration limitation	UDINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
1301	0x2183.01	Velocity limiting status	BOOL

Parameter	Index.Subindex	Name	Data type
1302	0x2183.02	Acceleration limiting status	BOOL
1303	0x2183.03	Torque limiting status	BOOL
1304	0x2183.04	Limit value velocity limit positive direction of movement	REAL
1305	0x2183.05	Upper limit value acceleration limitation	REAL
1306	0x2183.06	Upper limit value deceleration limitation	REAL
1307	0x2183.07	Upper limit torque limitation	REAL
1308	0x2183.08	Lower limit torque limitation	REAL
1309	0x2183.09	Velocity override	REAL
1310	0x2183.0C	Limit value velocity limit negative direction of movement	REAL
1311	0x2183.0D	Lower limit value acceleration limitation	REAL
1312	0x2183.0E	Lower limit value deceleration limit	REAL

Tab. 253 Objects

9.4.2.1.2 PROFIdrive

Application limitation PNUs

Parameter	PNU	Name	Data type
Px.	**Profile-specific parameters**		
11280611	205.0	Velocity override ➔ Velocity Override (OVERRIDE)	Integer16
Px.	**Manufacturer-specific parameters**		
1301	11331.0	Velocity limiting status	Boolean
1302	11332.0	Acceleration limiting status	Boolean
1303	11333.0	Torque limiting status	Boolean
1304	11334.0	Limit value velocity limit positive direction of movement	FloatingPoint
1305	11335.0	Upper limit value acceleration limitation	FloatingPoint
1306	11336.0	Upper limit value deceleration limitation	FloatingPoint
1307	11337.0	Upper limit torque limitation	FloatingPoint
1308	11338.0	Lower limit torque limitation	FloatingPoint
1309	12482.0	Velocity override	FloatingPoint
1310	12644.0	Limit value velocity limit negative direction of movement	FloatingPoint
1311	12645.0	Lower limit value acceleration limitation	FloatingPoint
1312	12646.0	Lower limit value deceleration limit	FloatingPoint
11280611	12534.0	Velocity override ➔ Velocity Override (OVERRIDE)	Integer16

Tab. 254 PNUs

9.4.2.2 Control limitation

The cascade controller has the following limitations:
– Limiter for the setpoint velocity
– Limiter for the setpoint torque and the setpoint active current
The limit values for the 2 limiters consist of static and dynamic data.

Data	Description
Dynamic data	Data consisting of the specifications of the user and the data from the I²t monitoring The data can be adjusted by the user at any time.
Static data	Data composed of the configuration of the HEPP gripper. The data can only be changed by changing the configuration.

Tab. 255

Limiter for setpoint velocity

The lower and upper velocity limit value (v_in1, v_in 2) specified by the user is compared with the limit value for the velocity of the HEPP gripper determined from the static data ➔ Fig. 53.
The resulting lower limit value of the velocity (–LIM2) is the higher limit value in each case. The resulting upper limit value of the velocity (+ LIM2) is the lower limit value in each case.
The resulting limit values (–LIM2, + LIM2) limit the output value of the position controller including the velocity pilot control ➔ Fig. 49.

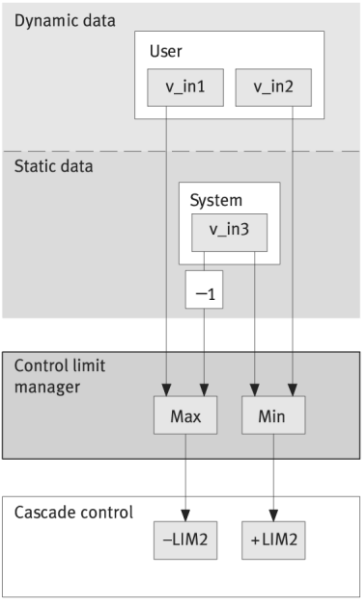


Fig. 53 Limiter for the setpoint velocity

Name	Parameter	ID Px.
v_in1	Lower limit value velocity (closed loop controller)	850
v_in2	Upper limit value velocity (closed loop controller)	851
v_in3	Maximum motor velocity Specifies the static limit value Maximum velocity of the motor in relation to the output side with gearbox.	382
–LIM2	Resulting lower limit value velocity (closed loop controller)	6100
+LIM2	Resulting upper limit value velocity (closed loop controller)	6101

Tab. 256 Legend for the block diagram limiter for setpoint velocity

Limiter for setpoint torque and setpoint active current

The lower and upper limit value of the torque (M_in1, M_in2) specified by the user is compared with the limit values of the HEPP gripper determined from the static data (M_in3, M_in4) ➔ Fig. 54.
The resulting lower limit value of the torque (-M) is the highest value in each case. The resulting upper limit value of the torque (+ M) is the lowest value in each case.
The lower and upper limit value of the active current (iq_in1, iq_in2) specified by the user is compared with the dynamic data of the I²T monitoring and the minimum and maximum currents of the HEPP gripper resulting from the static data.
The resulting lower limit value of the active current (–iq) is the highest value in each case.
The resulting upper limit value of the active current (+ iq) is the lowest value in each case. The resulting values (-M, + M, –iq, + iq) are input values for the torque limiter ➔ Fig. 55.

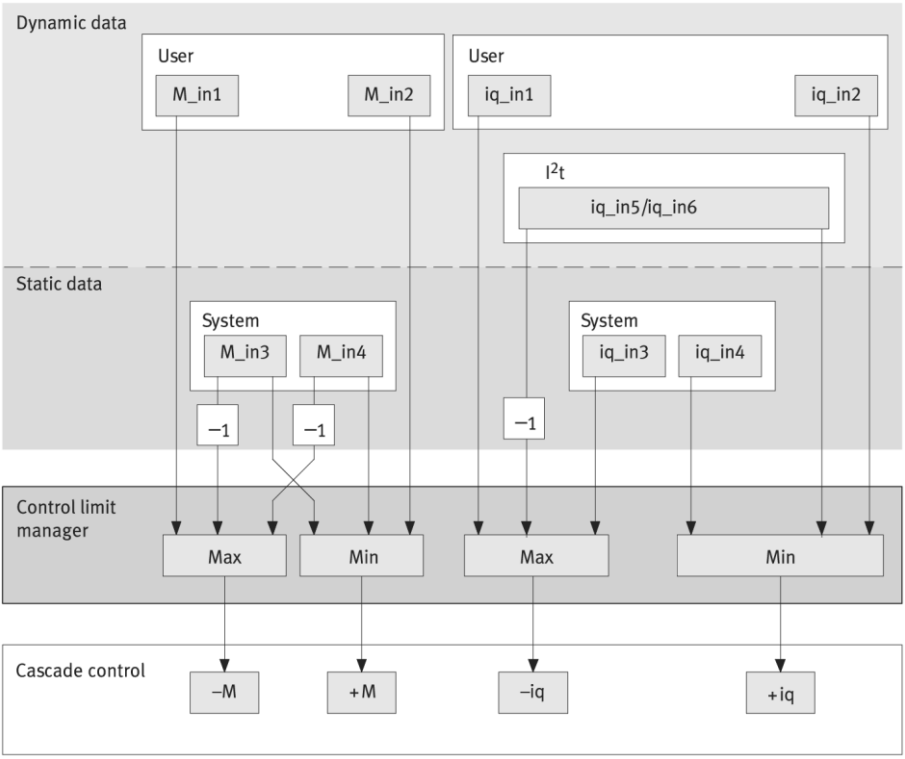


Fig. 54 Limiter for the setpoint torque and the setpoint active current

Name	Parameter	ID Px.
M_in1	Lower limit value torque (closed loop controller)	852
M_in2	Upper limit value torque (closed loop controller)	853
M_in3	Maximum motor torque Specifies the maximum torque from the minimum values of the HEPP gripper relative to the output side with gearbox.	381
M_in4	Maximum driving torque axis	1199
–M	Resulting lower limit value torque (closed loop controller)	6104
+M	Resulting upper limit value torque (closed loop controller)	6105
iq_in1	Lower limit value active current (closed loop controller)	854
iq_in2	Upper limit value active current (closed loop controller)	855
iq_in3	Resulting minimum current Specifies the static limit value "Minimum current" created from the minimum of the maximum values of the HEPP gripper with negative signs.	625

Name	Parameter	ID Px.
iq_in4	Resulting maximum current Specifies the static limit value "Maximum current" created from the minimum of the maximum values of the HEPP motor or drive.	624
iq_in5	When the limit value is reached, the current of the HEPP motor is limited to the resulting nominal current (ID Px.621).	–
iq_in6	When the limit value is reached, the current of the power output stage is limited to the resulting nominal current (ID Px.623).	–
–iq	Resulting lower limit value active current (closed loop controller)	6108
+iq	Resulting upper limit value active current (closed loop controller)	6109

Tab. 257 Legend for the block diagram limiter for setpoint torque and setpoint active current

Parameters and diagnostic messages

ID Px.	Parameter	Description	
381	Maximum motor torque/servo drive	Specifies the maximum torque from the minimum values of the HEPP motor or drive relative to the output side with gearbox.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
382	Maximum motor velocity	Specifies the static limit value Maximum velocity of the HEPP motor in relation to the output side with gearbox.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
624	Resulting maximum current	Specifies the static limit value "Maximum current" created from the minimum of the maximum values of the HEPP motor or drive.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
625	Resulting minimum current	Specifies the static limit value "Minimum current" created from the minimum of the maximum values of the HEPP motor or drive with negative signs.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
850	Lower limit value velocity (closed loop controller)	Specifies the dynamic limit value "Lower limit value of velocity" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

ID Px.	Parameter	Description	
851	Upper limit value velocity (closed loop controller)	Specifies the dynamic limit value "Upper limit value of velocity" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
852	Lower limit value torque (closed loop controller)	Specifies the dynamic limit value "Lower limit value of the torque" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
853	Upper limit value torque (closed loop controller)	Specifies the dynamic limit value "Upper limit value of the torque" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
854	Lower limit value act ive current (closed loop controller)	Specifies the dynamic limit value "Lower limit value of the active current" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	Arms
855	Upper limit value active current (closed loop controller)	Specifies the dynamic limit value "Upper limit value of the active current" specified by the user.	
		Access	read/write
		Update	effective immediately
		Unit	Arms
1199	Maximum driving torque axis	Specifies the maximum driving torque of the axis.	
		Access	read/write
		Update	reinitialization
		Unit	Nm
6100	Resulting lower limit value velocity (closed loop controller)	Specifies the limit value "Lower limit value of velocity" for velocity limiting.	
		Access	read/–
		Update	effective immediately
		Unit	user defined
6101	Resulting upper limit value velocity (closed loop controller)	Specifies the limit value "Upper limit value of velocity" for velocity limiting.	
		Access	read/–
		Update	effective immediately
		Unit	user defined

ID Px.	Parameter	Description	
6104	Resulting lower limit value torque (closed loop controller)	Specifies the resulting minimum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
6105	Resulting upper limit value torque (closed loop controller)	Specifies the resulting maximum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
6108	Resulting lower limit value active current (closed loop control ler)	Specifies the limit value "Lower limit value of the active current". (Conversion to the output-side torque is an internal calculation)	
		Access	read/–
		Update	effective immediately
		Unit	Arms
6109	Resulting upper limit value active current (closed loop control-ler)	Specifies the limit value "Upper limit value of the active current". (Conversion to the output-side torque is an internal calculation)	
		Access	read/–
		Update	effective immediately
		Unit	Arms

Tab. 258 Parameter

ID Dx.	Name	Description
06 | 02 | 00087 (100794455)	Velocity control limitation invalid	Velocity control limitation invalid
06 | 02 | 00088 (100794456)	Torque control limitation invalid	Torque control limitation invalid
06 | 02 | 00089 (100794457)	Current control limitation invalid	Current control limitation invalid
06 | 02 | 00090 (100794458)	Maximum peak current control limita-tion invalid	Maximum peak current control limita-tion invalid

Tab. 259 Diagnostic messages

9.4.2.2.1 CiA 402

Control limitation objects

Parameter	Index.Subindex	Name	Data type
Px.	CiA402: The factor group is effective.		
852	0x60E1.00	Lower limit value torque (closed loop control-ler)	UINT
853	0x60E0.00	Upper limit value torque (closed loop control ler)	UINT
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is ef-fective.		

Parameter	Index.Subindex	Name	Data type
381	0x2169.01	Maximum motor torque/servo drive	REAL
382	0x2169.02	Maximum motor velocity	REAL
624	0x2169.07	Resulting maximum current	REAL
625	0x2169.08	Resulting minimum current	REAL
850	0x2168.01	Lower limit value velocity (closed loop controller)	REAL
851	0x2168.02	Upper limit value velocity (closed loop controller)	REAL
852	0x2168.03	Lower limit value torque (closed loop controller)	REAL
853	0x2168.04	Upper limit value torque (closed loop controller)	REAL
854	0x2168.05	Lower limit value active current (closed loop controller)	REAL
855	0x2168.06	Upper limit value active current (closed loop controller)	REAL
1199	0x217E.09	Maximum driving torque axis	REAL
6100	0x2168.08	Resulting lower limit value velocity (closed loop controller)	REAL
6101	0x2168.09	Resulting upper limit value velocity (closed loop controller)	REAL
6104	0x2168.0C	Resulting lower limit value torque (closed loop controller)	REAL
6105	0x2168.0D	Resulting upper limit value torque (closed loop controller)	REAL
6108	0x2168.10	Resulting lower limit value active current (closed loop controller)	REAL
6109	0x2168.11	Resulting upper limit value active current (closed loop controller)	REAL

Tab. 260 Objects

9.4.2.2.2 PROFIdrive

Control limitation PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
381	11122.0	Maximum motor torque/servo drive	FloatingPoint
382	11123.0	Maximum motor velocity	FloatingPoint
624	11163.0	Resulting maximum current	FloatingPoint
625	11164.0	Resulting minimum current	FloatingPoint
850	11212.0	Lower limit value velocity (closed loop control ler)	FloatingPoint
851	11213.0	Upper limit value velocity (closed loop controller)	FloatingPoint

Parameter	PNU	Name	Data type
852	11214.0	Lower limit value torque (closed loop controller)	FloatingPoint
853	11215.0	Upper limit value torque (closed loop controller)	FloatingPoint
854	11216.0	Lower limit value active current (closed loop controller)	FloatingPoint
855	11217.0	Upper limit value active current (closed loop controller)	FloatingPoint
1199	11301.0	Maximum driving torque axis	FloatingPoint
6100	11640.0	Resulting lower limit value velocity (closed loop controller)	FloatingPoint
6101	11641.0	Resulting upper limit value velocity (closed loop controller)	FloatingPoint
6104	11644.0	Resulting lower limit value torque (closed loop controller)	FloatingPoint
6105	11645.0	Resulting upper limit value torque (closed loop controller)	FloatingPoint
6108	11648.0	Resulting lower limit value active current (closed loop controller)	FloatingPoint
6109	11649.0	Resulting upper limit value active current (closed loop controller)	FloatingPoint

Tab. 261 PNUs

9.4.2.3 Torque limitation

The torque limitation limits the torque related to the HEPP output shaft end directly at the output of the velocity controller. For HEPP gripper with gear unit the shaft end of the gear unit output is on the HEPP output side.
Current limit values from the configuration of the HEPP gripper and the specifications of the user are converted internally to a resulting torque based on the shaft end on the drive output side ➔ Fig. 55
The input values -M, + M, –iq, + iq are the output values of the limiter for setpoint torque and setpoint active current ➔ Fig. 54.
The resulting limit values (–LIM1, + LIM1) limit the output value (iq_ref) of the velocity controller, including the torque pilot control ➔ Fig. 50.

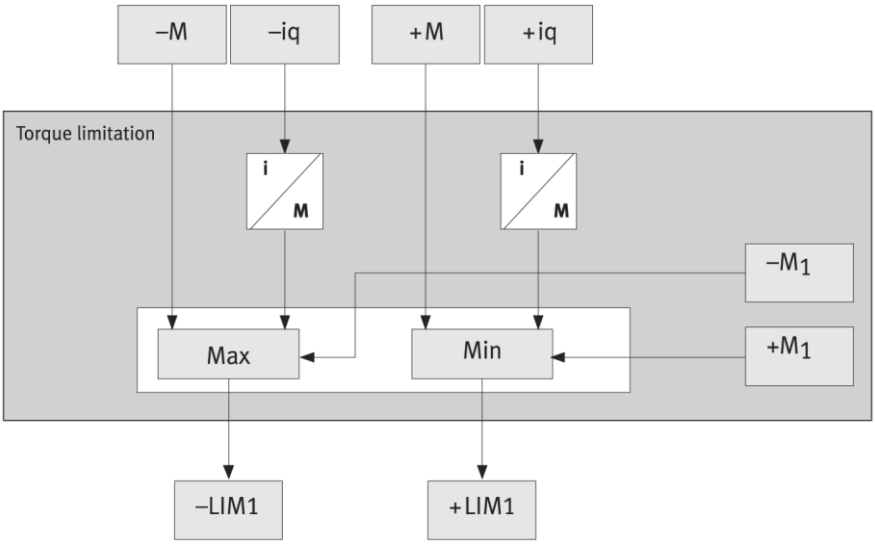


Fig. 55 Torque limiter structure

Name	Parameter	ID Px.
–iq	Resulting lower limit value active current (closed loop controller)	6108
+iq	Resulting upper limit value active current (closed loop controller)	6109
–M	Resulting lower limit value torque (closed loop controller)	6104
+M	Resulting upper limit value torque (closed loop controller)	6105
–M1 +M2	Resulting limit value from the reactive current reduction, which also acts on the torque limitation	–
–LIM1	Minimum torque This value is additionally limited by Px.526796, Maximum torque symmetrical.	2218
+LIM1	Maximum torque This value is additionally limited by Px.526796, Maximum torque symmetrical.	2219

Tab. 262 Legend for the block diagram of the torque limiter

The resulting limit values iq are the result of the control limitation ➔ 9.4.2.2 Control limitation.
The minimum torque LIM1- and the maximum torque LIM1 + affect the output of the velocity controller ➔ 9.4.1.3 Velocity controller.

Inertia compensation

The inertia of the motor, gear unit and coupling reduces the effective torque at the output shaft end. Therefore, the specified value for the torque limitation is not fully available for acceleration of the load. This can be compensated by the following parameters:

– Inertia Gear (Px.124321)

– Inertia coupling (Px.124322)
– Dynamic losses (Px.124323)

The resulting limit values + Lim and –Lim consist of the static limit value of the axis Px.1199 and the dynamic compensation of the inertia. The resulting limit values + Lim and –Lim affect the limit value M_in4 ➔ Fig. 54.

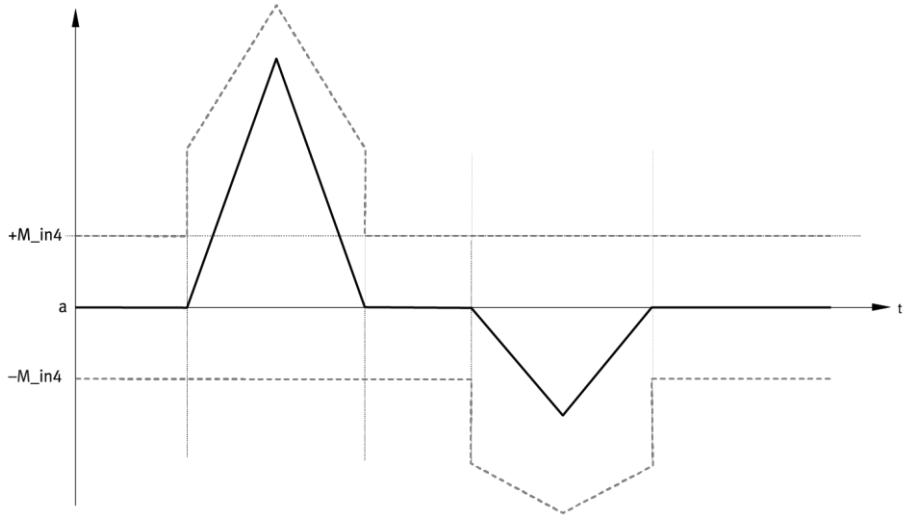


Fig. 56 Inertia compensation

Name	Description	ID Px.
a	Acceleration in user units	–
+M_in4	resulting maximum driving torque of the axis	1199
–M_in4		

Tab. 263 Legend

Parameters and diagnostic messages

ID Px.	Parameter	Description	
87	Setpoint value reactive current	Specifies the reactive current setpoint for the current controller.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
856	Limit value total current (closed loop con troller)	Specifies the limit value of the total current for the HEPP gripper	
		Access	read/write
		Update	effective immediately
		Unit	Arms

ID Px.	Parameter	Description	
2218	Minimum torque	Specifies the minimum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
2219	Maximum torque	Specifies the maximum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
6104	Resulting lower limit value torque (closed loop controller)	Specifies the resulting minimum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
6105	Resulting upper limit value torque (closed loop controller)	Specifies the resulting maximum torque for torque limitation.	
		Access	read/–
		Update	effective immediately
		Unit	Nm
6108	Resulting lower limit value active current (closed loop controller)	Specifies the limit value "Lower limit value of the active current". (Conversion to the output-side torque is an internal calculation)	
		Access	read/–
		Update	effective immediately
		Unit	Arms
6109	Resulting upper limit value active current (closed loop controller)	Specifies the limit value "Upper limit value of the active current". (Conversion to the output-side torque is an internal calculation)	
		Access	read/–
		Update	effective immediately
		Unit	Arms
6112	Resulting upper limit value total current (closed loop controller)	Specifies the limit value of the total current.	
		Access	read/–
		Update	effective immediately
		Unit	Arms
124321	Inertia Gear	Indicates the total inertia of all gears in the drive train. The value is required for increasing the torque limitation during the acceleration and deceleration phase.	
		Access	read/write
		Update	reinitialization
		Unit	kgm²
124322	Inertia coupling	Indicates the inertia of the clutch in the drive train. The value is required for increasing the torque limitation during the accelera tion and deceleration phase.	

ID Px.	Parameter	Description	
		Access	read/write
		Update	reinitialization
		Unit	kgm²
124323	Dynamic losses	Indicates the static dynamic losses in Nm related to the drive side. The value is required for increasing the torque limitation during the acceleration phase.	
		Access	read/write
		Update	reinitialization
		Unit	Nm

Tab. 264 Parameter

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.4.2.3.1 CiA 402

Torque limitation objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
87	0x2153.08	Setpoint value reactive current	REAL
856	0x2168.07	Limit value total current (closed loop controller)	REAL
2218	0x215B.0A	Minimum torque	REAL
2219	0x215B.0B	Maximum torque	REAL
6104	0x2168.0C	Resulting lower limit value torque (closed loop controller)	REAL
6105	0x2168.0D	Resulting upper limit value torque (closed loop controller)	REAL
6108	0x2168.10	Resulting lower limit value active current (closed loop controller)	REAL
6109	0x2168.11	Resulting upper limit value active current (closed loop controller)	REAL
6112	0x2168.14	Resulting upper limit value total current (closed loop controller)	REAL
124321	0x2182.0F	Inertia Gear	REAL
124322	0x217F.0A	Inertia coupling	REAL
124323	0x217E.0B	Dynamic losses	REAL

Tab. 265 Objects

9.4.2.3.2 PROFIdrive

Torque limitation PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
87	11042.0	Setpoint value reactive current	FloatingPoint
856	11218.0	Limit value total current (closed loop controller)	FloatingPoint
2218	11414.0	Minimum torque	FloatingPoint
2219	11415.0	Maximum torque	FloatingPoint
6104	11644.0	Resulting lower limit value torque (closed loop controller)	FloatingPoint
6105	11645.0	Resulting upper limit value torque (closed loop controller)	FloatingPoint
6108	11648.0	Resulting lower limit value active current (closed loop controller)	FloatingPoint
6109	11649.0	Resulting upper limit value active current (closed loop controller)	FloatingPoint
6112	11652.0	Resulting upper limit value total current (closed loop controller)	FloatingPoint
124321	12448.0	Inertia Gear	FloatingPoint
124322	12449.0	Inertia coupling	FloatingPoint
124323	12450.0	Dynamic losses	FloatingPoint

Tab. 266 PNUs

9.4.3 Pilot control (closed-loop control setpoint values)

9.4.3.1 Setpoint value connection

The pilot control (FFC feed forward control) creates the setpoint values for the cascade controller, e.g. from

– the time derivations of the set values
– a constant value (offset)

This ensures that the positioning behavior of the HEPP gripper is greatly improved, e.g. a reduction of the contouring error or improved run-in behavior to the target position.

The input variables for the pilot control are directly connected to the output variable or are adjusted using a mathematical operation:

– Output variables with the same physical meaning are added within the pilot control component. The added value can additionally be influenced by a weighting factor (gain).
– Each mathematical operation with the input variables v (velocity) and a (acceleration) has a deceleration element of the first order connected in series. An inactive time element is connected in series for the position.

A constant value can be stipulated for the weight force compensation.

The following pilot control values are valid for the various operating modes of the cascade controller.

The pilot control also acts in the interpolating operating modes via a fieldbus.

Input variable	Output variable	Pilot control	Mode of operation[1]		
			P	V	T
V	v	Velocity (default)	•	–	–
A	M	Torque (inertia)	•	•	–
V	M	Torque (friction)	•	•	–
–	M	Torque (constant value)	•	•	•

1) P = positioning mode, V = velocity mode, T = torque mode

Tab. 267 Pilot control

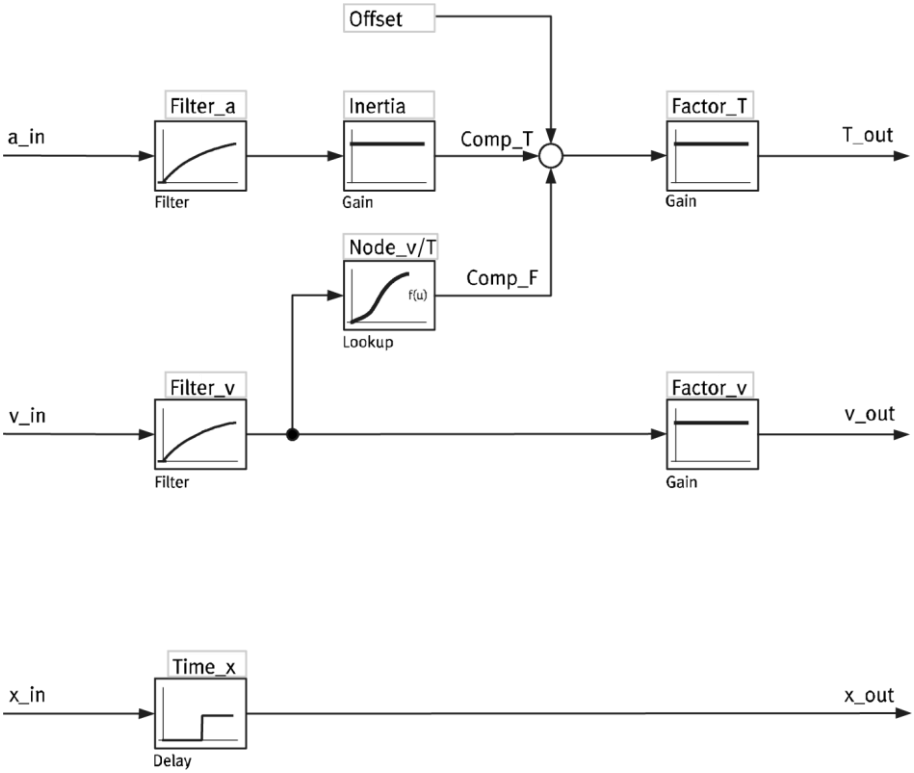


Fig. 57 Pilot control

Name	Description	ID Px.
x_in, v_in, a_in	Position, velocity and acceleration setpoint values as input variables of the pilot control	
	Setpoint management output position	290
	Setpoint management output velocity	291
	Setpoint management output acceleration	292

Name	Description	ID Px.
x_out, v_out, T_out	Setpoint values for the cascade controller	
	Setpoint value position	90
	Setpoint value velocity	91
	Setpoint value torque	94
t_x <- Time_x	Inactive time position setpoint value (whole-number multiple of the device specific scanning time of the closed-loop controller)	957
t_v <- Filter_v	Time constant velocity setpoint value filter	958
t_a <- Filter_a	Time constant acceleration setpoint value filter	959
Factor_v	Amplification gain velocity feed forward control	967
Factor_T	Amplification gain torque feed forward control	968
Offset	Offset torque	969
Inertia	Total inertia	973
Comp_F	Setpoint value friction compensation The parameter can be used, for example, to assess the component of the feed forward control from the friction compensation by means of measured data recording (trace).	974
Comp_T	Setpoint value inertia compensation The parameter can be used, for example, to assess the component of the feed forward control from the inertia compensation by means of measured data recording (trace).	975
Node_v	Support point velocity [rad/s]	976
Node_T	Support point torque [Nm]	977

Tab. 268 Legend for the block diagram of pilot control

Certain parameters of the pilot control are not entered in user units but, e.g., in Nm and their derivations.
The inertia for the inertia compensation is stipulated in kgm² (Px.973) and the support points of the table for the friction compensation Node_T (Px.976) in Nm.

Parameter

ID Px.	Parameter	Description	
90	Setpoint value position	Position output from feed forward control as setpoint value for the closed-loop controller	
		Access	read/–
		Update	effective immediately
		Unit	user defined
91	Setpoint value velocity	Velocity output from feed forward control as setpoint value for the closed-loop controller	
		Access	read/–

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	user defined
92	Setpoint value acceleration	Acceleration output from feed forward control as setpoint value for the closed-loop controller	
		Access	read/–
		Update	effective immediately
		Unit	user defined
93	Setpoint value jerk	Jerk output from feed forward control as setpoint value for the closed-loop controller	
		Access	read/–
		Update	effective immediately
		Unit	user defined
94	Setpoint value torque	Torque output from feed forward control as setpoint value for the closed-loop controller	
		Access	read/–
		Update	effective immediately
		Unit	Nm
95	Feed forward control current output	Current output from feed forward control	
		Access	read/–
		Update	effective immediately
		Unit	Arms
957	Inactive time position setpoint value	Indicates the dead time of the position setpoint in integer samples of the position control loop.	
		Access	read/write
		Update	effective immediately
		Unit	–
958	Time constant velocity setpoint value filter	Time constant velocity setpoint value filter	
		Access	read/write
		Update	effective immediately
		Unit	s
959	Time constant acceleration setpoint value filter	Time constant acceleration setpoint value filter	
		Access	read/write
		Update	effective immediately
		Unit	s
967	Amplification gain velocity feed forward control	Amplification gain velocity feed forward control	
		Access	read/write
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
968	Amplification gain torque feed forward control	Amplification gain torque feed forward control	
		Access	read/write
		Update	effective immediately
		Unit	–
969	Offset torque	Specifies the offset for a torque.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
973	Total inertia	Specifies the total inertia torque of the HEPP drive train (axis, gear unit, motor, load). A value input by the user is overwritten with the total of all inertias from the configured HEPP drive train, including the load, by calculation of the control parameters.	
		Access	read/write
		Update	effective immediately
		Unit	kgm²
974	Setpoint value friction compensation	The parameter can be used, for example, to assess the compon ent of the feed forward control from the friction compensation by means of measured data recording (trace).	
		Access	read/–
		Update	effective immediately
		Unit	Nm
975	Setpoint value inertia compensation	The parameter can be used, for example, to assess the component of the feed forward control from the inertia compensation by means of measured data recording (trace).	
		Access	read/–
		Update	effective immediately
		Unit	Nm
977	Support point torque [Nm]	Maximum of 16 support points via Index 0...15. Torque [Nm] of the HEPP drive train (axis, gear unit, motor, load) based on the gear unit output.	
		Access	read/write
		Update	effective immediately
		Unit	Nm
978	Number of support points	Number of support points for which the look-up table friction compensation is to be used.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 269 Parameter

9.5 Diagnostics and fault clearance

9.5.1 Diagnostics options

The HEPP gripper provides comprehensive diagnostics options. The status LEDs of the device display the current status information. Fieldbus-specific diagnostic functions are available via the fieldbus. The device saves all of the messages in the volatile message directory. The device also has a non-volatile error memory. Messages, for which the history should be traceable at a later date, are recorded in the error memory. The classification of errors ensures that the response to the error by the device can be adjusted to individual requirements. The device provides the trace function to analyze errors and for optimization purposes. The trace function can, for example, be used to simultaneously record various measuring data for a diagnostic event.

Diagnostics options	Brief description
On-site via LEDs	The LEDs, for example, display the following: – Device status – Status of the power supply – Status of the device interfaces – Status of the safety equipment For additional information see "Description, assembly and installation" ➔ 1 Applicable documents.
Diagnostics via fieldbus – Request diagnostic status – Fieldbus-specific diagnostic functions	Special diagnostic functions and communication services are available, depending on the fieldbus used.

Tab. 270 Diagnostics options

9.5.2 Classification of Diagnostic Events

If a diagnostic event occurs, the device issues a message and reacts according to the parameterized severity of the diagnostic event. For many of the messages, the severity of a diagnostic event can be specified within certain limits by parameterizing the classification.
The following levels are available:
– Ignore
– Information
– Warning
– Error, stop category 2
– Error, stop category 1
– Error, stop category 0

Classification (level)	Severity	Reactions
Ignore	Diagnostic event of minor importance	– Generation of the message and entry in the message directory; the event has no further influence. No entry is added to the error memory as standard

Tab. 271 Ignore level

Classification (level)	Severity	Reactions
Information	Diagnostic event with low degree of severity	– Generation of the message and entry in the message directory; the event has no further influence. No entry is added to the error memory as standard

Tab. 272 Information level

Classification (level)	Severity	Reactions
Warning	Diagnostic event with medium degree of severity to inform about impending error states	– Generation of the message and entry in the message directory – The status LED indicates the warning. – No change to the operating status – No change to the ready signal – Depending on the configuration, an entry is added to the error memory.

Tab. 273 Warning level

Classification (level)	Severity	Reactions
Error, stop category 2	Diagnostic event with high degree of severity and execution of a general and a specific error response	Stop category 2 general error response – Generation of the message and entry in the message directory – The device switches to the error status. – Status LED indicates the error (flashing red). – The normally open contact RDY-C1/2 is opened (ready = open). – Depending on the configuration, an entry is added to the error memory specific error response of category 2 – The HEPP gripper is decelerated using the parameterized stop ramp as soon as the error occurs. – When the HEPP gripper has reached velocity 0, the closed-loop controller maintains the HEPP gripper at the position achieved upon completion of the stop ramp.

Tab. 274 Error Level, Stop Category 2

Classification (level)	Severity	Reactions
Error, stop category 1	Diagnostic event with high degree of severity and execution of a general and a specific error response	Stop category 1 General error response – The same as with stop category 2. Specific error response of category 1 – The HEPP gripper is decelerated using the defined stop ramp as soon as the error occurs. When the HEPP gripper is at a standstill, the brake engages and the closed-loop controller is switched off upon expiry of the

Classification (level)	Severity	Reactions
		deceleration delay. The HEPP gripper is switched off directly at standstill without brake.

Tab. 275 Error Level, Stop Category 1

Classification (level)	Severity	Reactions
Error, stop category 0	Diagnostic event with high degree of severity and execution of a general and a specific error response	Stop category 0 general response – The same as with stop category 2. specific error response of category 0 – The output stage is switched off immediately after the error has occurred. The brake locks on HEPP with brake. Without a brake the HEPP runs down.

Tab. 276 Error Level, Stop Category 0

9.5.3 Diagnostic status

The device determines the diagnostic status from the severity of the active messages. The diagnostic status is a bit mask that represents the severity of all of the triggered messages in the device. The following can be determined by requesting the diagnostic status:

– If active messages are pending (diagnostic status parameter › 0)
– If errors are pending (diagnostic status parameter ≥ 64)
– levels of severity (e. g. diagnostic status ≥ 4096 corresponds to stop category 0)

Diagnostic status			
Bit	Value	Description	Priority
1	2	1 = Ignore	Lowest
2	4	1 = Information	...
4	16	1 = Warning	
Error limit			
6	64	1 = Error stop category 2	
8	256	1 = Error stop category 1	
12	4096	1 = Error stop category 0	Highest

Tab. 277 Diagnostic status

The diagnostic status parameter can be requested via the device profile of the fieldbus being used.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
300	Diagnostic device status	Diagnostic status of the device	
		Access	read/–
		Update	effective immediately
		Unit	–

ID Px.	Parameter	Description	
112819	Error active	Displays whether an error is pending	
		Access	read/–
		Update	effective immediately
		Unit	–

Tab. 278 Parameter

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.5.3.1 Classification of Diagnostic Events

Diagnostic status objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
300	0x210D.01	Diagnostic device status	UINT
112819	0x218E.09	Error active	BOOL

Tab. 279 Objects

9.5.3.2 PROFIdrive

Diagnostic status PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
300	2081.0	Diagnostic device status	Unsigned16
112819	12036.0	Error active	Boolean

Tab. 280 PNUs

9.5.4 HEPP gripper messages

9.5.4.1 Status of messages

Messages can have the following statuses:

Status	Description
Active	The triggering diagnostic event is still active.
Cancelled	The triggering diagnostic event is no longer active. The message was therefore cancelled internally.
Acknowledged	The triggering diagnostic event is no longer active. The message was therefore cancelled internally. The message was then acknowledged by an external command or an external signal.

Tab. 281 Status of messages

The messages remain active as long as the diagnostic event is active (e. g. high temperature of power unit). Once the diagnostic event is no longer active, the message can be acknowledged. The acknowledgement resets the error response of the device again (e. g. LED display). The device switches to the

error status when errors occur. The error status remains active until all of the errors have been acknowledged by an external command or an external signal. The error status is quit again once all of the error messages have been acknowledged.

9.5.4.2 Structure of messages

Messages for diagnostic events consistently contain the following features:

Characteristic	Brief description
Message ID	unique identification of the diagnostic event
Name	brief description of the diagnostic event
Status	Status of the message: – active = diagnostic event is pending – cancelled = diagnostic event is no longer pending – acknowledged = the cancelled message has been acknowledged
Classification	Level of the message, corresponding to severity level: – Ignore – Information – Warning – Error stop category 0, 1 or 2
Time stamp	Time of occurrence of a diagnostic event in operating hours. Display: ‹days›.‹hours›:‹minutes›:‹seconds›.‹milliseconds›

Tab. 282 Structure of messages

Complete list of all diagnostic messages ➔ 9.5.4.6 Diagnostic messages with information for fault clearance.

Structure of the message ID

The message ID consists of:

– System- (D0 ...) or axis label (D1...)
– 1- or 3-part diagnostic number, derived from the main error group, error subgroup and error number
  ➔ Representation of the diagnostic number
  ➔ Main/sub-groups of the message ID
– Instance for identifying the affected component

Message ID						Description
1	2	3	4	5	6	System message ID overcurrent error
D	0.	16842763			0	1-part diagnostic number
D	0.	01	01	00011.	0	3-part diagnostic number – Main group = 01 ➔ current – Sub-group = 01 ➔ I^2t – Error number = 00011 ➔ overcurrent error

Tab. 283 Example of message ID overcurrent error

D	System/ axis	ID diagnostic number			Instance
		Main group	Subgroup	Number	
.	.	.	.	.	[6] ➔ Identifier of the affected component with similar components. Example: Position Capture 1 and Position Capture 2
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.		
.	.	.	.	[5] ➔ ID error number	
.	.	.	[4] ➔ Sub-group as a function of the main group, e.g. logic supply, DC link supply		
.	.	.			
.	.	[3] ➔ Main group of the error, e.g. current, voltage, temperature error			
.	[2] ➔ Identification of the system or axis: 0 = system x = number of the related axis (1 = axis 1, 2 = axis 2, ...)				
.					
.					
[1] ➔ Identification D = Diagnostics					

Tab. 284 Message ID Dx ...

Representation of the diagnostic number

The diagnostic number is optionally displayed in 2 variants:

– 1-part = 1 resulting number from main group, sub-group and error number
– 3 parts = 3 individual numbers for main group, sub-group and error number.

The variants are determined via the hexadecimal/decimal conversion. Proceed as follows to determine the 1-part diagnostic number:

1. Combine main group, sub-group and error number byte by byte as a hexadecimal 4-byte value:
   Main group = byte 4
   Sub-group = byte 3
   Error number = byte 2 and 1
2. Convert the resulting hexadecimal 4-byte number into a decimal number. This results in the 1-part diagnostic number.

Main group	Sub-group	Error number	Comments
Byte 4	Byte 3	Byte 2 ... 1	
02	02	00031	3-part diagnostic number, decimal
Conversion of dec ➔ hex			
0x 02	0x 02	0x 00 1F	Individual value, hexadecimal
Grouping			
0x 02 02 00 1F			Grouping of the individual values (4-byte number), hexadecimal
Conversion hex ➔ dec			
33685535			1-part diagnostic number, decimal

Tab. 285 Display variants of the diagnostic number (example)

If the device profile only allows 16 bit, only the ID error number 5 is transferred

- Example of message ID overcurrent error

The 1-part diagnostic number of the currently most serious diagnostic event can be read out via the following parameters:

– Instance 0: Px.315.0.0
  CiA object 0x2145.0B
  PNU 3376.0
– Instance 1: Px.315.1.0
  CiA object 0x2145.0C
  PNU 3377.0

Main/sub-groups of the message ID

Main group	Sub-group		
01	Current	01	Short circuit
		02	I²t
02	Voltage	01	Supply
		02	DC link circuit
		03	Principal voltage
		04	Encoder supply
03	Temperature	01	Device
		02	Output stage
		03	Motor
05	Motion	01	Homing
		02	Motion Control
06	Configuration/parameterization	00	No allocation
		02	Limit values
		05	Parameter set
07	Monitoring	01	Limitations
		02	Motion monitoring
		03	Limit values
		04	Zero angle detection
08	Communication	00	No allocation
		04	EtherCAT
09	Safety engineering	00	No allocation
		01	STO
10	Internal hardware	01	Module Error
11	Software	01	Exception
		02	Task

Main group	Sub-group		
		03	File system
		05	Device configuration
		06	LibRTE
		07	Warm start
11	Software	08	Version management
12	Maintenance	01	Operating time
13	Various	01	Diagnostics
17	Security (data)	01	User login
18	Encoder	00	No allocation
		03	Quadrature (incremental encoder)

Tab. 286 Main and sub-groups of the message ID

9.5.4.3 Message directory

All messages are stored in the volatile message directory of the device. The sequence of the entries is determined by the time when they occurred and the severity. The sorting of the message directory is as follow:

– Severity in descending order (messages with a higher degree of severity come first)
– Time stamp in ascending order (older messages come first)

9.5.4.4 Error memory

Messages, for which the history should be traceable at a later date, are recorded in the error memory. These are usually error messages. The recording of other selected messages can also be set ➔9.5.4.6 Diagnostic messages with information for fault clearance.
The error memory is designed as a non-volatile ring memory. The relevant messages are written consecutively to the ring memory. Whenever the ring memory is full, the oldest message is overwritten when a new message arrives (FIFO principle).
The sequence of the entries is determined by the time when they occurred. The latest message is in first position of the error memory, ready to be read out.

9.5.4.5 Acknowledging messages and errors

Acknowledging messages initiates the following:

– All cancelled messages switch to the "acknowledged" status ➔ 9.5.4.1 Status of messages.
– All active messages remain active (cannot be acknowledged).
– If acknowledged successfully, the reaction of the corresponding message is retracted (e. g. status LED off).
– The error status is closed again if all of the errors have been acknowledged successfully.

If messages remain active, the cause must first be eliminated so that they can be cancelled internally. Only cancelled messages can be acknowledged.

Serious errors cannot be acknowledged. In this case, the error status may be able to be closed by switching the device on again (power OFF/ON). If the serious error immediately occurs again, please contact Festo Service team (service required).

Information on troubleshooting ➔ 9.5.4.6 Diagnostic messages with information for fault clearance.
Messages and errors are acknowledged via:
– the device profile of the field bus being used

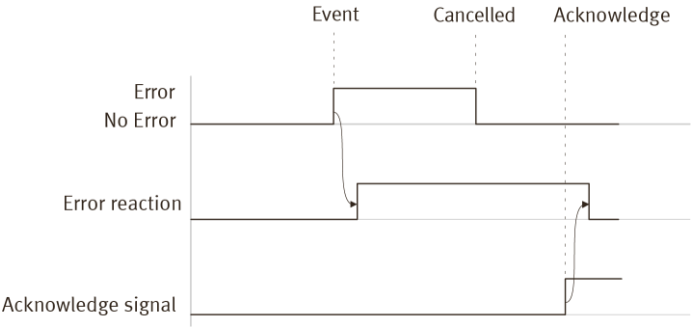


Fig. 58 Acknowledgement

Name	Description
Error/No error	Error/no error
Error reaction	Reaction of the device
Acknowledge signal	Signal or command for acknowledgment
Event	Diagnostic event, e.g. error
Cancelled	Message cancelled internally
Acknowledge	Acknowledgement

Tab. 287 Legend for acknowledgement timing diagram

9.5.4.6 Diagnostic messages with information for fault clearance

Structure of reference list for the diagnostic messages

The reference list for the diagnostic messages is structured as follows:

ID Dx.	Message	Description		
01 | 02 | 00012 (16908300) [1]	I²t monitoring: motor warning limit [2]	I²t monitoring: motor warning limit		[3]
		Remedy	– Reduce dynamic response of tasks – Motor/mechanical system blocked or sluggish?	[4]

ID Dx.	Message	Description		
		Classification	Default: Warning (16)	5
			Can be parameterized: Px.6319 Value list: Warning (16) Information (4) Ignore (2)	6
		Error	Default: Save (1)	7
		memory	Can be parameterized: Px.6320	8

Tab. 288 Sample diagnostic message

Cell	Content/description
1	Diagnostic number in grouped overview. Followed by the diagnostic number in brackets in the ungrouped overview.
2	Name of the message
3	Description of the diagnostic event
4	Remedy: remedial measures
5	Classification: default error response (factory setting)
6	Specification of whether classification can be parameterized: – no: error response cannot be parameterized – Parameter ID Px... = error response can be parameterized Value list: list of error responses that can be parameterized
7	Error memory: default setting of whether message is added to the error memory
8	Specification of whether addition to the error memory can be parameterized: – Can be parameterized: no = addition cannot be parameterized – Parameter ID Px... = addition can be parameterized The value list always applies: – Do not save (0) – Save (1)

Tab. 289 Legend for sample diagnostic message

The following reference list for the diagnostic messages is sorted by the ID in the grouped overview.

ID Dx.	Message	Description	
01 | 01 | 00010 (16842762)	Short circuit motor phases/braking resistor	Short circuit motor phases/braking resistor	
		Remedy	– Check wiring and rectify short circuit
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
01 | 01 | 00011 (16842763)	Overcurrent monitoring	Error on overcurrent monitoring	
		Remedy	– Check wiring STO and reference switch – Is too much current flowing there (short circuit?)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
01 | 02 | 00012 (16908300)	I²t monitoring: motor warning limit	I²t monitoring: motor warning limit	
		Remedy	– Reduce dynamics of movement orders – Check holding brake – Motor/mechanism blocked or stiff?
		Classification	Default: Ignore (2)
			Can be parameterized: Px.6319, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6320
01 | 02 | 00013 (16908301)	I²t monitoring: motor error limit	I²t monitoring: motor error limit	
		Remedy	– Motor/mechanics blocked or stiff? – Motor undersized? – Power dimensioning Check drive package – Check holding brake
		Classification	Default: Ignore (2) Can be parameterized: Px.6321, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6322

ID Dx.	Message	Description	
01 | 02 | 00014 (16908302)	I²t monitoring: output stage warning limit	I²t monitoring: output stage warning limit	
		Remedy	– Motor/mechanics blocked or stiff? – Motor undersized? – Power dimensioning check drive package – Check holding brake
		Classification	Default: Ignore (2)
			Can be parameterized: Px.6323, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6324
01 | 02 | 00015 (16908303)	I²t monitoring: output stage error limit	I²t monitoring: output stage error limit	
		Remedy	– Motor/mechanics blocked or stiff? – Motor undersized? – Power dimensioning check drive package – Check holding brake
		Classification	Default: Ignore (2)
			Can be parameterized: Px.6325, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6326
01 | 02 | 00016 (16908304)	I²t monitoring: output stage v0 warning limit	I²t monitoring: output stage in standstill warning limit	
		Remedy	– reduce set current / set torque – Reduce downtime – Allow movement >5 Hz electrical rotational frequency
		Classification	Default: Ignore (2)
			Can be parameterized: Px.6327, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6328

ID Dx.	Message	Description	
01 | 02 | 00017 (16908305)	I²t monitoring: output stage v0 error limit	I²t monitoring: output stage in standstill error limit	
		Remedy	– reduce set current / set torque – Reduce downtime – Allow movement >5 Hz electrical rotational frequency
		Classification	Default: Ignore (2)
			Can be parameterized: Px.6329, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.6330
01 | 02 | 00018 (16908306)	Parameterization I²t: motor monitoring invalid	Parameterization I²t: motor monitoring invalid	
		Remedy	– Check parameterization for I²t limit value (Px.7144) – Nominal current (Px.7117) and maximum current (Px.7120) of the motor plausible?
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
01 | 02 | 00258 (16908546)	I²T monitoring: motor model warning limit	I²T monitoring: motor model warning limit	
		Remedy	– Reduce dynamics of movement orders – Check holding brake – Motor/mechanism blocked or stiff?
		Classification	Default: Warning (16)
			Can be parameterized: Px.63019, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.63020
01 | 02 | 00259 (16908547)	I²t monitoring: motor model error limit	I²t monitoring: motor model error limit	
		Remedy	– Reduce dynamics of movement orders – Check holding brake – Motor/mechanism blocked or stiff?
		Classification	Default: Stop category 1 (256)

ID Dx.	Message	Description	
			Can be parameterized: Px.63021, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.63022
02 | 01 | 00022 (33619990)	Under-voltage in logic supply 24V	Under-voltage in logic supply 24V	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 01 | 00023 (33619991)	Over-voltage in logic supply 24V	Over-voltage in logic supply 24V	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096) Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 01 | 00024 (33619992)	Undervoltage in logic supply 5V	Undervoltage in logic supply 5V internal	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 01 | 00025 (33619993)	Overvoltage in logic supply 5V	Overvoltage in logic supply 5V internal	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 01 | 00026 (33619994)	Undervoltage in logic supply 3.3V	Undervoltage in logic supply 3.3V internal	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
02 | 01 | 00027 (33619995)	Overvoltage in logic supply 3.3V internal	Overvoltage in logic supply 3.3V internal	
		Remedy	– Check power supply.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 02 | 00030 (33685534)	Overvoltage in DC link	Overvoltage in DC link	
		Remedy	– Check braking resistor dimensioning, value too high – Reduce deceleration dynamics – Check limit value for DC link switch-off (P0.4812)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 02 | 00031 (33685535)	Undervoltage in DC link	Undervoltage in DC link	
		Remedy	– Check power supply – Couple DC links, if technically permissible – Check DC link voltage (measure) – Check undervoltage monitoring (threshold value) (P0.4814)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.487, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.488
02 | 02 | 00032 (33685536)	DC link warning threshold reached	DC link warning threshold reached	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: Px.489, value list: – Warning (16) – Information (4) – Ignore (2)

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: Px.4890
02 | 03 | 00038 (33751078)	Undervoltage in load voltage	Undervoltage in load voltage	
		Remedy	– Check power supply – Power failure detection correctly parameterized (P0.493)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.519, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.5180
02 | 03 | 00039 (33751079)	Overvoltage in load voltage	Overvoltage in load voltage	
		Remedy	– Check power supply – Power failure detection correctly parameterized (P0.494)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
02 | 03 | 00251 (33751291)	Limit value of energy recovery exceeded	The limit value for the energy recovery has been exceeded	
		Remedy	– Check power supply – Check parameters for the switch-off threshold (P0.10185)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
03 | 01 | 00044 (50397228)	Warning threshold: Insufficient temperature in device	Warning threshold: Insufficient temperature in device	
		Remedy	– Check ambient conditions – Check parameterization warning threshold (P0.9312)
		Classification	Default: Warning (16) Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.933

ID Dx.	Message	Description	
03 | 01 | 00045 (50397229)	Temperature in device too low	Temperature in device too low	
		Remedy	– Check ambient conditions – Check parameterization of switch-off threshold (P0.9313)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
03 | 01 | 00046 (50397230)	Warning threshold: Device overtemperature	Warning threshold: device overtemperature	
		Remedy	– Check parameterization warning threshold (P0.9310) – Unit fan defective? – Device overloaded? – Check installation conditions, filter of control cabinet fan dirty? – Check HEPP dimensioning (possible over-load in continuous operation)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.937
03 | 01 | 00047 (50397231)	Device overtemperature	Device overtemperature	
		Remedy	– Check parameterization warning threshold (P0.9311) – Unit fan defective? – Device overloaded? – Check installation conditions, filter of control cabinet fan dirty? – Check HEPP dimensioning (possible over-load in continuous operation)
		Classification	Default: Stop category 1 (256) Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
03 | 02 | 00048 (50462768)	Warning threshold: Insufficient temperature in power unit	Warning threshold: Insufficient temperature in power unit	
		Remedy	– Check ambient conditions – Check parameterization warning threshold (P0.9316)
		Classification	Default: Warning (16)

ID Dx.	Message	Description	
			Can be parameterized: Px.922, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.923
03 I 02 I 00049 (50462769)	Insufficient temperature in power unit	Insufficient temperature in output stage	
		Remedy	– Check ambient conditions – Check parameterization of switch-off threshold (P0.9317)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
03 I 02 I 00050 (50462770)	Warning threshold: Power unit overtemperature	Warning threshold: Power unit overtemperature	
		Remedy	– Check parameterization warning threshold (P0.9314) – Unit fan defective? – Device overloaded? – Check installation conditions, filter of con trol cabinet fan dirty? – Check HEPP dimensioning (possible overload in continuous operation)
		Classification	Default: Warning (16)
		Error memory	Default: save (1)
			Can be parameterized: Px.927
03 I 02 I 00051 (50462771)	Power unit overtemperature	Power unit overtemperature	
		Remedy	– Check parameterization warning threshold (P0.9315) – Unit fan defective? – Device overloaded? – Check installation conditions, filter of control cabinet fan dirty? – Check HEPP dimensioning (possible overload in continuous operation)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 01 | 00057 (83951673)	Homing: Timeout	Homing: Timeout	
		Remedy	– Check timeout for homing (Px.842) – At end stop: check parameters for standstill window (Px.8415) and limit monitoring (Px8414) – Increase dynamic values for homing
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.8452, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64)
		Error memory	Default: save (1)
			Can be parameterized: Px.8453
05 | 01 | 00058 (83951674)	Homing: Search path exceeded	Homing: Search path exceeded	
		Remedy	– Check arrangement slide to limit switch / end stop – Parameterization search path (Px.8412, Px.8413)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.8454, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64)
		Error memory	Default: save (1)
			Can be parameterized: Px.8455
05 | 02 | 00059 (84017211)	Positioning command invalid	Command invalid	
		Remedy	*Check parameterization motion task or record*
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00060 (84017212)	Motion task not known	Unknown motion task pending	
		Remedy	– Check order, record number or step-on condition
		Classification	Default: stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 02 | 00061 (84017213)	Task ignored controller enable failed	Task could not be executed as the HEPP control is missing	
		Remedy	– Controller enable via fieldbus missing
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00062 (84017214)	Task ignored as safety function requested	Task could not be executed as a safety function is requested	
		Remedy	– Check inputs of safety function for correct logic level
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00064 (84017216)	Task ignored as DC link coupling not ready	Task could not be executed as no DC link voltage is present or this has not yet been detected	
		Remedy	– Check mains voltage for present – Check the DC voltage when the DC power supply Is activated – Check braking resistor for presence, if required
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00065 (84017217)	Task ignored due to motion task error	The motion task was rejected in the current status	
		Remedy	– Cancel current movement order with a stop – Wait for MC for the current movement order
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.1733
05 | 02 | 00066 (84017218)	Task ignored as encoder not ready	Task could not be executed as the encoder is not ready	
		Remedy	– Check encoder cable – Check voltage supply for the encoder
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 02 | 00067 (84017219)	Task ignored as referencing missing	Task could not be executed as the HEPP drive is not referenced	
		Remedy	– reference HEPP drive
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00068 (84017220)	Task ignored as reinitialization is required	Task could not be executed as a reinitialisation is required due to a parameter change	
		Remedy	– Performing Reinitialization
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00069 (84017221)	Task ignored as restart is required	Task could not be executed as a restart is required due to a parameter change	
		Remedy	– Save configuration and restart the device
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00071 (84017223)	Trajectory generator error	An error occurred in the trajectory generator when calculating a movement profile	
		Remedy	– Check parameterization order or block (complete unrealistic values?)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.30127, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64)
		Error memory	Default: save (1)
			Can be parameterized: Px.30128
05 | 02 | 00072 (84017224)	Invalid position preset of trajectory generator	The position specified for the trajectory generator is invalid	
		Remedy	– Change position specification to the valid range, see documentation
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 02 | 00073 (84017225)	Invalid velocity value of trajectory generator	The velocity specified for the trajectory generator is invalid	
		Remedy	– Change speed default to the valid range, see documentation
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00074 (84017226)	Invalid acceleration value of trajectory generator	The acceleration specified for the trajectory generator is invalid	
		Remedy	– Change acceleration default to the valid range, see documentation
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00075 (84017227)	Invalid deceleration value of trajectory generator	The deceleration specified for the trajectory generator is invalid	
		Remedy	– Change delay setting to the valid range, see documentation
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00076 (84017228)	Invalid jerk value of trajectory generator	The jerk specified for the trajectory generator is invalid	
		Remedy	– Change jerk setting to the valid range, see documentation
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00077 (84017229)	Trajectory generator error	An error occurred in the trajectory generator when calculating a movement profile	
		Remedy	– Adjust dynamic values for the movement order
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 02 | 00078 (84017230)	Stop ramp: Timeout	Stop ramp: Timeout	
		Remedy	– Check parameterization of standstill monitoring (Px.465, Px.466)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00079 (84017231)	Torque increase ramp invalid	The torque increase ramp is invalid	
		Remedy	– Change parameters for the torque rise ramp to the valid range
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.1130225, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.1130226
05 | 02 | 00080 (84017232)	Simultaneous negative/positive directional lock	Simultaneous negative/positive directional lock	
		Remedy	– Check HW limit switch logic
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00278 (84017430)	Task ignored because directional lock active	Task could not be executed because a directional lock is active	
		Remedy	– Observe further diagnostic messages and eliminate the cause of the directional lock – Carry out movement into the valid work area.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
05 | 02 | 00279 (84017431)	Fixed stop not detected	Fixed stop was not detected	
		Remedy	– Check if workpiece is in front of the target position

ID Dx.	Message	Description	
		Classification	Default: Information (4)
			Can be parameterized: Px.4647, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4648
05 | 02 | 00280 (84017432)	Monitoring window of fixed stop left	Monitoring window of fixed stop left	
		Remedy	– Check if workpiece was not lost
		Classification	Default: Information (4)
			Can be parameterized: Px.4649, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4650
05 | 02 | 00282 (84017434)	Encoder not ready	Selected encoder not ready for brake test	
		Remedy	– Check whether selection of encoder interface valid – Check whether encoder errors are present
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.103136, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.103137

ID Dx.	Message	Description	
05 | 02 | 00283 (84017435)	Brake test failed	Brake test failed	
		Remedy	– Check brake wear – Check monitoring window stroke (Px.103117.x.0)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.103138, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.103139
05 | 02 | 00284 (84017436)	Torque failed brake test	Torque for brake test cannot be built up	
		Remedy	– Check brake wear – Check Torque monitoring window (Px103118.x.0)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.103140, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.103141
05 | 02 | 00364 (84017516)	Profile velocity = 0	The preset profile velocity is 0. The HEPP gripper does not move and does not reach its target position.	
		Remedy	– Check profile speed (record table / direct operation) – Check speed override (Px.1309, Px.11280611)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
05 | 02 | 00431 (84017583)	Invalid limit value Application limitation	At least one limit value (Px.1304 ... Px.1312) is outside its validity range	
		Remedy	– Check values for limitations (min value ‹ max value)?
		Classification	Default: Stop category 2 (64)
			Can be parameterized: Px.53, value list: – Stop category 0 (4096) – Stop category 1a (1024) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2) – Intern (1) – Invalid (0)
		Error memory	Default: save (1)
			Can be parameterized: Px.18
06 | 00 | 00070 (100663366)	Invalid record table parameter	A record table parameter is invalid	
		Remedy	– Check record table parameters
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.1852, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64)
		Error memory	Default: save (1)
			Can be parameterized: Px.1853
06 | 00 | 00081 (100663377)	Controller operating mode invalid	The operating mode of the controller (position, velocity, force, stop) does not match the parameterization	
		Remedy	– Check the parameterization of the controller (Px.4001, Px.4005, Px.40069)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 00 | 00082 (100663378)	Notch filter frequency invalid	The parameterization of the notch filter frequency is invalid	
		Remedy	– Check parameterization notch filter frequency, notch filter frequency is greater than half the sampling frequency (Px.40.0.x)

ID Dx.	Message	Description	
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 00 | 00083 (100663379)	Record table incorrect	Record table incorrect	
		Remedy	– Check motion record number
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.1850, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64)
		Error memory	Default: save (1)
			Can be parameterized: Px.1851
06 | 00 | 00084 (100663380)	Parameterization switching frequency	Parameterization of switching frequency invalid	
		Remedy	– Check parameter set, matches the device? – Check parameterization PWM frequency (P0.670)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 00 | 00252 (100663548)	Incorrect parameterization of reactive current braking	The start and end voltages for reactive current braking are incompatible	
		Remedy	– Check parameterization reactive current braking (Px.102108, Px.102109)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 00 | 00313 (100663609)	Invalid parameterization variable message function	The variable message function is incorrectly parameterized.	
		Remedy	– Check input parameters for data trigger (Px.1174201 ... 1174207)
		Classification	Default: Warning (16)
			Can be parameterized: Px.1174230, value list: – Warning (16) – Information (4) – Ignore (2)

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: Px.1174231
06 | 02 | 00086 (100794454)	Sign limits	The target torque and the velocity limit are uncorrelated.	
		Remedy	– Check torque and current limitations, signs and limitations must match (symmetrical?)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00087 (100794455)	Velocity control limitation invalid	Velocity control limitation invalid	
		Remedy	– Check configuration of control limitation (Px.850, Px.851)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00088 (100794456)	Torque control limitation invalid	Torque control limitation invalid	
		Remedy	– Check configuration of control limitation (Px.852, Px.853)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00089 (100794457)	Current control limitation invalid	Current control limitation invalid	
		Remedy	– Check configuration of control limitation (Px.854, Px.855)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00090 (100794458)	Maximum peak current control limitation invalid	Maximum peak current control limitation invalid	
		Remedy	– Check configuration of control limitation (Px.856)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00091 (100794459)	Parameterization of currents	Parameterization of nominal current/maximum peak current of HEPP invalid	

ID Dx.	Message	Description	
		Remedy	– Check parameterization for rated current (Px.7117) and maximum current (Px.7120) (consistency)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00273 (100794641)	Change of control structure not permissible	The change of the control structure is not permissible	
		Remedy	– Wait until current movement order is completed – Check movement order
		Classification	Default: Warning (16)
			Can be parameterized: Px.4020, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4021
06 | 02 | 00274 (100794642)	Motion command not permissible	The motion command is not permissible in controlled operation	
		Remedy	– Check movement order
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 02 | 00275 (100794643)	Change to closed loop operation not permissible	Change to closed loop operation not permissible because the commutation angle is not valid	
		Remedy	– Perform commutation angle determination
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 05 | 00097 (100991073)	Parameter set not found	Parameter set not found	
		Remedy	– Check selection of parameter set
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 05 | 00098 (100991074)	Parameter set invalid	Parameter set invalid	
		Remedy	– Overwrite (save) parameter set
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 05 | 00099 (100991075)	Parameter set incompatible	Parameter set incompatible	
		Remedy	– Delete parameter set – Overwrite (save) parameter set
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 05 | 00100 (100991076)	Parameter not found	Parameter not found	
		Remedy	– Delete parameter set – Overwrite (save) parameter set
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
06 | 05 | 00101 (100991077)	Parameter read-only	Parameter read-only	
		Remedy	– Delete parameter set – Overwrite (save) parameter set
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5709
06 | 05 | 00102 (100991078)	Transmission error in parameter set	Transmission error in parameter set	
		Remedy	– Repeat transmission – Check connection
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5711

ID Dx.	Message	Description	
06 | 05 | 00103 (100991079)	Parameter set: store failed	Parameter set: store failed	
		Remedy	– Repeat saving – Service case
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5713
06 | 05 | 00104 (100991080)	Parameter set: delete failed	Parameter set: delete failed	
		Remedy	– Parameter set available? – Repeat deletion – Service case
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5715
06 | 05 | 00105 (100991081)	Factory parameter not found	A factory parameter was not found	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5727
06 | 05 | 00106 (100991082)	Factory parameter set invalid	The factory parameter set is invalid	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5723
06 | 05 | 00107 (100991083)	Factory parameter set not found	The factory parameter set was not found	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5721
06 | 05 | 00108 (100991084)	Factory parameter set incompatible	The factory parameter set is incompatible	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: no

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: Px.5725
07 | 01 | 00109 (117506157)	Negative software limit position	Negative software limit position reached	
		Remedy	– Check movement trajectory (close to end stop)? – Check values for software end positions (Px.4629, Px.4630) – Check whether automatic braking is active (Px.4631) – Parameters of stop ramp (Px.12101, Px.12111) lower than trajectory parameters, increase stop ramp parameters
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.4632, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4633
07 | 01 | 00110 (117506158)	Positive software limit position	Positive software limit position reached	
		Remedy	– Check movement trajectory (close to end position)? – Check values for software end positions (Px.4630) – Check whether automatic braking is active (Px.4631) – Parameters of stop ramp (Px.12101, Px.12111) lower than trajectory parameters, increase stop ramp parameters
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.4634, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: Px.4635
07 | 01 | 00111 (117506159)	Limitation negative direction	Limitation of direction of movement owing to negative software limit position	
		Remedy	– Check movement order
		Classification	Default: Warning (16)
			Can be parameterized: Px.4636, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4637
07 | 01 | 00112 (117506160)	Limitation positive direction	Limitation of direction of movement owing to positive software limit position	
		Remedy	– Check movement order
		Classification	Default: Warning (16)
			Can be parameterized: Px.4638, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4639
07 | 01 | 00113 (117506161)	Parameterization of software limit positions	Parameterization of software limit positions invalid	
		Remedy	– Check values for software end positions (consistency, negative Px.4629 < positive end position Px4630)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
07 | 01 | 00119 (117506167)	Negative stroke limit reached	Negative stroke limit reached	
		Remedy	– Check movement order – Check parameterization stroke limit (Px.10368)
		Classification	Default: Stop category 1 (256)

ID Dx.	Message	Description	
			Can be parameterized: Px.4676, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4677
07 | 01 | 00120 (117506168)	Positive stroke limit reached	Positive stroke limit reached	
		Remedy	– Check movement order – Check parameterization stroke limit (Px.10369)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.4678, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4679
07 | 02 | 00121 (117571705)	Target position reached	Target position reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.4612, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4613
07 | 02 | 00122 (117571706)	Target velocity reached	Target velocity reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)

ID Dx.	Message	Description	
			Can be parameterized: Px.4614, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4615
07 | 02 | 00123 (117571707)	Target torque reached	Target torque reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.4616, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4617
07 | 02 | 00124 (117571708)	Standstill reached	Standstill reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.4618, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4619
07 | 02 | 00125 (117571709)	Standstill reached and in standstill window	Standstill reached and in standstill window	
		Remedy	– none (info only)
		Classification	Default: Information (4)

ID Dx.	Message	Description	
			Can be parameterized: Px.4620, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4621
07 | 02 | 00126 (117571710)	Position: following error	Position: following error	
		Remedy	– Investigate causes of contouring errors (Trace) – Reduce dynamic values – Check error window (Px.463)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.4622, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4623
07 | 02 | 00127 (117571711)	Velocity: following error	Velocity: following error	
		Remedy	– Investigate causes of contouring errors (Trace) – Reduce dynamic values – Check error window (Px.464)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.4624, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4625

ID Dx.	Message	Description	
07 | 02 | 00128 (117571712)	Velocity too high	RPM monitoring reports velocity too high	
		Remedy	– Check maximum velocity configuration (Px.4660) – Reduce set velocity – Check offset angle, perform commutation angle determination
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
07 | 02 | 00129 (117571713)	Out of target range	HEPP has left the target range	
		Remedy	– Check target range window and settling time (Px.4665 ... Px.4667) – Monitoring makes sense for application? Possibly deactivate monitoring (Px.4669)
		Classification	Default: Warning (16)
			Can be parameterized: Px.4669, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.4670
07 | 02 | 00130 (117571714)	Reverse feed monitoring	Reverse feed monitoring reports error	
		Remedy	– Check parameterization (Px.4663, Px.4664) – Monitoring makes sense for application? Possibly deactivate monitoring (Px.4671)
		Classification	Default: Information (4)
			Can be parameterized: Px.4671, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4672

ID Dx.	Message	Description	
07 | 02 | 00131 (117571715)	Residual distance too low	Residual distance too low	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.4686, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4687
07 | 02 | 00132 (117571716)	Trajectory completed	Trajectory completed (setpoint value reached)	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.4691, Value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.4692
07 | 03 | 00134 (117637254)	Voltage limiting active	Voltage limiting active	
		Remedy	– Reduce velocity – Reduce torque
		Classification	Default: Information (4)
			Can be parameterized: Px.52682, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.52683

ID Dx.	Message	Description	
07 | 03 | 00135 (117637255)	Limit for velocity or current active	A limit for the velocity or current is active	
		Remedy	• Reduce dynamic values for the motion task • Check parameters for velocity limitation (Px.850, Px.851) • Check parameters for current limitation (Px.854 ... Px.856)
		Classification	Default: Information (4)
			Can be parameterized: Px.52677, value list: – Information (4) – Invalid (0)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.52678
07 | 04 | 00136 (117702792)	Commutation finding failed	Commutation finding failed	
		Remedy	– Check encoder (valid values / connected) – For vertical axes with load: reduce load mass – Reduce step size (Px.664) – Reduce dynamic values (Px.669, Px.6691, Px.6692)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
07 | 04 | 00137 (117702793)	Commutation finding direction error	An error has occurred during the commutation angle search, the direction of rotation of the motor does not corelate with the position from the encoder.	
		Remedy	– Motor shaft freewheeling? – Increase current injection for commutation angle finding (Px.270) – Axle jammed? – Adjust dynamic values for commutation angle finding (Px.669, Px.6691, Px.6692) – Check whether the direction of rotation of the encoder (P0.1171.0.0) and that of the motor (Px.1172) match.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
07 | 05 | 00138 (117768330)	Analogue setpoint specification limit exceeded	Limits for analogue setpoint specification exceeded	
		Remedy	– Check limit values (Px.998, Px.999) – Check scaling (Px.995)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.9914
08 | 00 | 00140 (134217868)	Failure of fieldbus synchronization signal	Failure of fieldbus synchronization signal	
		Remedy	– Check wiring – Check PLC configuration
		Classification	Default: Stop category 1 (256)
			Can be parameterized:: Px.801, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.802
08 | 00 | 00243 (134217971)	Invalid cycle time	Cycle time is not an integral multiple of 1 ms	
		Remedy	– Check the cycle time is an integer multiple of 1 ms
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 03 | 00141 (134414477)	Invalid process data	The process data is invalid	
		Remedy	– Check mapping of process data
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 03 | 00373 (134414709)	Failure of synchronization signal Fieldbus	The maximum number of failed synchronization signals was exceeded.	
		Remedy	– Check wiring – Check PLC configuration
		Classification	Default: Stop category 1 (256)

ID Dx.	Message	Description	
			Can be parameterized: Px.54545, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.54546
08 | 03 | 00391 (134414727)	PROFINET process data communication failed	PROFINET process data communication failed	
		Remedy	– Check communication PROFINET (connector, master) etc...
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 04 | 00142 (134480014)	EtherCAT process data invalid	Parameterization of process data invalid	
		Remedy	– Check parameterization EtherCAT communication
		Classification	Default: Stop category 1 (256)
			Can be parameterized:: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 04 | 00143 (134480015)	EtherCAT process data communication failed	EtherCAT process data communication failed	
		Remedy	– Check communication EtherCAT (connector, master) etc...
		Classification	Default: Stop category 1 (256)
			Can be parameterized:: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 04 | 00281 (134480153)	Process data not received at Sync time	Process data not received at Sync time. Changes in classification are not permanently saved	
		Remedy	– Check connection between process data and Sync time in the controller
		Classification	Default: Stop category 1 (256)
			Can be parameterized:: Px.758, value list: – Stop category 0 (4096) – Stop category 1a (1024) – Stop category 1 (256) – Stop category 2 (64)

ID Dx.	Message	Description	
			– Warning (16) – Information (4) – Ignore (2) – Intern (1) – Invalid (0)
		Error memory	Default: save (1)
			Can be parameterized: Px.759
08 | 09 | 00144 (134807696)	Required application class not supported	The required application class is not supported	
		Remedy	– Only request the application class supported by the device (see documentation)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.11280111
08 | 09 | 00145 (134807697)	Telegram not supported	The required telegram is not supported	
		Remedy	– request only the telegrams supported by the device (see documentation)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.11280203
08 | 09 | 00288 (134807840)	PROFIdrive test error message 1	PROFIdrive test error message 1	
		Remedy	– Cancel error test message via PNU
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 09 | 00289 (134807841)	PROFIdrive test error message 2	PROFIdrive test error message 2	
		Remedy	– Cancel error test message via PNU
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 09 | 00294 (134807846)	PLC Control is not set	The PLC Control bit is not set	
		Remedy	– Set PLC control bit (STW1.Bit10)
		Classification	Default: Stop category 0 (4096)

ID Dx.	Message	Description	
			Can be parameterized: Px.11280117, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.11280118
08 | 09 | 00299 (134807851)	Error Sign of Life	The number of failed sign of Life signals was exceeded.	
		Remedy	– Check PROFINET communication – Check whether the life sign is sent correctly by the controller (e.g. create trace with STW2.12 ... STW2.15 and trigger signal ZSW1.3). – Check the permissible failure rate of the telegrams (PNU 925). – Check bus or controller for utilization.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 09 | 00382 (134807934)	Invalid configuration extended process data	The extended process data is configured invalid.	
		Remedy	– Check mapping of the extended process data
		Classification	Default: Stop category 1 (256)
			Can be parameterized: Px.424201, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.424202
08 | 12 | 00250 (135004410)	Invalid mode of operation	An invalid mode of operation was requested	
		Remedy	– Check requested CiA402 operating mode
		Classification	Default: Stop category 2 (64)

ID Dx.	Message	Description	
			Can be parameterized: Px.12236, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.12237
08 | 12 | 00272 (135004432)	Resolution of position factor group invalid	The resolution of the position factor group is invalid	
		Remedy	– Adjust parameterization position factor group (Px.7841 ... Px.7844)
		Classification	Default: Warning (16)
			Can be parameterized: Px.45, value list: – Stop category 0 (4096) – Stop category 1a (1024) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2) – Intern (1) – Invalid (0)
		Error memory	Default: save (1)
			Can be parameterized: Px.46
08 | 13 | 00394 (135070090)	Invalid process data	The process data is invalid	
		Remedy	– New configuration of the EtherNet/IP interface (see documentation)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
08 | 13 | 00395 (135070091)	Telegram not supported	The required telegram is not supported	
		Remedy	– request only the telegrams supported by the device (see documentation)
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.11280203

ID Dx.	Message	Description	
09 | 00 | 00146 (150995090)	Safety function requested	Safety function requested	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: Px.821, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: do not save (0)
			Can be parameterized: Px.822
09 | 00 | 00147 (150995091)	Plausibility check of safety feedback signals	Error during plausibility check of safety feedback signals	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
09 | 01 | 00148 (151060628)	STO: Discrepancy time exceeded	Discrepancy time for #STO-A/B exceeded	
		Remedy	– Timing Check input signals STO – Configuration Check discrepancy time (Px.391)
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
09 | 01 | 00149 (151060629)	Plausibility check #STO-A/B	Plausibility check of #STO-A/B input	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
09 | 01 | 00150 (151060630)	Sequence monitoring #STO-A/B	Sequence monitoring, #STO-A/B inputs	
		Remedy	– Timing and sequence check input signals STO
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: no
09 | 02 | 00151 (151126167)	Plausibility check #SBC-A/B	Plausibility check of #SBC-A/B input effective	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
09 | 02 | 00152 (151126168)	SBC: Discrepancy time exceeded	Discrepancy time for #SBC-A/B exceeded	
		Remedy	– Timing Check input signals SBC – Configuration Check discrepancy time (Px.437)
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
10 | 01 | 00153 (167837849)	RTE module cannot be reached	RTE module cannot be reached	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
10 | 01 | 00154 (167837850)	Initialization of RTE module failed	Initialization of RTE module failed	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 2 (64)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
10 | 01 | 00156 (167837852)	Common error power output stage	Error power output stage	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
10 | 01 | 00249 (167837945)	Watch dog error communication module	Monitoring function for the communication module has reported an error	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 01 | 00159 (184615071)	Data directory memory full	Data directory memory full	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 01 | 00160 (184615072)	Data directory indexed twice	Data directory indexed twice	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 01 | 00161 (184615073)	Overflow diagnostic register	Overflow in diagnostic register, messages not currently acknowledged	
		Remedy	– Acknowledge messages – Remedy causes for currently pending messages
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 01 | 00162 (184615074)	Overflow buffer diagnostic register	Overflow buffer in diagnostic register, messages currently not acknowledged	
		Remedy	– Acknowledge messages – Remedy causes for currently pending messages
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
11 | 01 | 00163 (184615075)	User unit error	An error has occurred when changing the user unit	
		Remedy	– Perform reinitialization again
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.11590
11 | 01 | 00244 (184615156)	Communication module supply voltage	The supply voltage to the communication module dropped	
		Remedy	– Check power supply – Restart device
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00164 (184680612)	Process runtime exceeded	Process runtime exceeded	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00165 (184680613)	Timeout process level 0	Timeout has occurred in process level 0	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00166 (184680614)	Timeout process level 1	Timeout has occurred in process level 1	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00167 (184680615)	Timeout process level 2	Timeout has occurred in process level 2	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
11 | 02 | 00168 (184680616)	Timeout process level 3	Timeout has occurred in process level 3	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00169 (184680617)	Timeout process level 4	Timeout has occurred in process level 4	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00170 (184680618)	Timeout process level 5	Timeout has occurred in process level 5	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00171 (184680619)	Timeout process level 6	Timeout has occurred in process level 6	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 02 | 00172 (184680620)	Timeout process level 7	Timeout has occurred in process level 7	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00174 (184746158)	File: user file (backup) invalid	The user file backup file is invalid	
		Remedy	– Restart device – Service case
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
11 | 03 | 00175 (184746159)	Creation of user file (backup) not possible	The creation of a backup file for the user file has failed	
		Remedy	– Restart device – Service case
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00176 (184746160)	CRC error in user file	A CRC error was detected in the user file	
		Remedy	– Restart device – Contact support
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00177 (184746161)	File: user file invalid	The user file is invalid	
		Remedy	– Restart device – Service case
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00178 (184746162)	New user file has been created	A new user file has been generated	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00179 (184746163)	Writing to user file not possible	It was not possible to write to the user file	
		Remedy	– Restart device – Service case
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 03 | 00180 (184746164)	Unknown user file error	An unknown error was triggered for the user file	
		Remedy	– Restart device – Service case
		Classification	Default: Information (4)

ID Dx.	Message	Description	
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00191 (184877247)	Calibration data incorrect: Safety	Calibration data incorrect: Safety	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00193 (184877249)	Device data incorrect: control unit	Device data incorrect: control unit	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00194 (184877250)	Device data incorrect: communication unit	Device data incorrect: communication unit	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00195 (184877251)	Device data incorrect: Safety	Device data incorrect: Safety	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00196 (184877252)	Calibration data incorrect: control unit	Calibration data incorrect: control unit	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00197 (184877253)	Calibration data incorrect: power unit	Calibration data incorrect: power unit	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00198 (184877254)	Device data incorrect: power unit	Device data incorrect: power unit	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00200 (184877256)	Current sensor calibration invalid	Current sensor calibration invalid	
		Remedy	– Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00201 (184877257)	Device not configured	Device not configured	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 05 | 00202 (184877258)	Store device failed	Store device failed	
		Remedy	– Restart device – Service case
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.5719
11 | 06 | 00203 (184942795)	Answer to a read request is missing in LibRTE	Answer to a read request is missing in LibRTE	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 06 | 00285 (184942877)	Error communication module mailbox	Internal software timeout with LibRTE communication	
		Remedy	– Restart device – Service case

ID Dx.	Message	Description	
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 06 | 00300 (184942892)	COM module error	Communication module error	
		Remedy	– Restart device – Service case
		Classification	Default: Stop category 1 (256)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 07 | 00204 (185008332)	Device initialization failed	The initialization of the device has failed	
		Remedy	– Check other diagnosis notifications. – Reset device to factory defaults.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
11 | 07 | 00205 (185008333)	Task ignored as reinitialization not possible	Requested reinitialization could not be executed	
		Remedy	– Reset controller enable
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.10328
11 | 07 | 00271 (185008399)	Reinitialization failed	The reinitialization failed	
		Remedy	– Check other diagnosis notifications. – Reset device to factory defaults.
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
12 | 01 | 00208 (201392336)	Maximum mileage value reached	Maximum value for the mileage is reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
12 | 01 | 00209 (201392337)	Mileage warning threshold reached	Threshold value 1 (default: warning threshold) for the mileage is reached	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: Px.1419, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.14110
12 | 01 | 00210 (201392338)	Mileage error threshold reached	Threshold value 2 (default: error threshold) for the mileage is reached	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: Px.14113, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.14114
12 | 01 | 00211 (201392339)	Maximum load change value reached	The maximum value for the load change is reached	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
12 | 01 | 00212 (201392340)	Load change warning threshold reached	Threshold value 1 (default: warning threshold) for the load change is reached	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: Px.1429, value list: – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.14210

ID Dx.	Message	Description	
12 | 01 | 00213 (201392341)	Load change error threshold reached	Threshold value 2 (default: error threshold) for the load change is reached	
		Remedy	– none (info only)
		Classification	Default: Warning (16)
			Can be parameterized: Px.14213, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.14214
13 | 01 | 00214 (218169558)	Message acknowledgment	Message acknowledgment completed	
		Remedy	– none (info only)
		Classification	Default: Internal (1)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
13 | 01 | 00215 (218169559)	Diagnostics log file has invalid format	Diagnostic memory invalid	
		Remedy	– Clear diagnostic memory
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: Px.100505
13 | 01 | 00216 (218169560)	Loss of messages from diagnostics log	Loss of messages from diagnostics log	
		Remedy	– Clear diagnostic memory
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
17 | 01 | 00224 (285278432)	Login completed	Login to access the device at a specific authorization level has been completed.	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
17 | 01 | 00225 (285278433)	Logout completed	Logout of the device at a specific authorization level has been completed.	
		Remedy	– none (info only)
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
17 | 01 | 00226 (285278434)	Login error	An error occurred during user login	
		Remedy	– Check password
		Classification	Default: Information (4)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 00 | 00092 (301989980)	Motor change detected, commutation angle invalid	Motor change detected, commutation angle invalid	
		Remedy	– run commutation angle finding and homing and save
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 00 | 00093 (301989981)	Motor change detected, zero point offset invalid	Motor change detected, zero point offset invalid	
		Remedy	– Perform homing and save parameter set
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 00 | 00094 (301989982)	Commutation angle in encoder invalid	Commutation angle in encoder invalid	
		Remedy	– Perform commutation angle determination
		Classification	Default: Stop category 0 (4096)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 00 | 00318 (301990206)	State transition error	The requested state transition is not supported.	
		Remedy	– Remove PROFIdrive command from control sequence
		Classification	Default: Stop category 2 (64)
			Can be parameterized: no

ID Dx.	Message	Description	
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 03 | 00301 (302186797)	Number of increments between two zero pulses invalid	Wrong zero pulse or incorrect number of increments per revolution	
		Remedy	– Check encoder cable – Restart the device
		Classification	Default: Warning (16)
			Can be parameterized: Px.10061, value list: – Stop category 0 (4096) – Stop category 1 (256) – Stop category 2 (64) – Warning (16) – Information (4) – Ignore (2)
		Error memory	Default: save (1)
			Can be parameterized: Px.10060
18 | 07 | 00365 (302449005)	Invalid request Gn_STW1.4...7	Invalid request for the control word Gn_STW1.4...7, bits reserved.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 07 | 00366 (302449006)	Function not supported Gn_STW1	An unsupported function in the control word Gn_STW1 is requested.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 07 | 00368 (302449008)	Error reference marks search	Error when searching for the reference marks, because the requested function is not completely configured.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

ID Dx.	Message	Description	
18 | 07 | 00369 (302449009)	Error Read Position Reference mark	Error when reading the position of the reference mark because the function is not completely configured.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 07 | 00370 (302449010)	Error measuring on the fly	Error when measuring the reference mark on the fly, because the function is not completely configured.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 07 | 00371 (302449011)	Error Read Position Measure on the fly	Error when reading the position Measure on the fly of the reference mark, because the function is not completely configured.	
		Remedy	– control word Check PROFIdrive encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no
18 | 07 | 00372 (302449012)	Error Transfer absolute position to Gn_XIST2	Error when transferring the absolute position to Gn_XIST2.	
		Remedy	– Check PROFIdrive encoder control word – Use of absolute encoder
		Classification	Default: Warning (16)
			Can be parameterized: no
		Error memory	Default: save (1)
			Can be parameterized: no

Tab. 290 Diagnostic messages

9.5.5 Condition monitoring

The condition monitoring function records the following data of the HEPP gripper and its axis over the entire service life:

– HEPP mileage
– HEPP load change
– Number of HEPP operating hours

The data are recorded with separate counters and stored as a remanent value approx. every 15 minutes. When the device is switched on again, the last stored values are restored and recording is continued.

9.5.5.1 Mileage counter

The mileage counter records the distance completed by the connected axis. The unwanted recording of small positioning differences is suppressed by a hysteresis function (random noise). Two threshold values can be specified per parameterization. A diagnostic message is issued if they are exceeded.
The reaction of the HEPP gripper when the threshold value is exceeded can be influenced by specifying the error category.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
1411	Mileage 1	Specifies the current mileage of the corresponding axis.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
1417	Mileage warning threshold	Specifies the first threshold value when the device should generate the first configured message. Warning threshold is deactivated at 0.	
		Access	read/write
		Update	effective immediately
		Unit	user defined
14111	Mileage error threshold	Specifies the second threshold value when the device should generate the second configured message. Error threshold is deactivated at 0.	
		Access	read/write
		Update	effective immediately
		Unit	user defined

Tab. 291 Parameter

ID Dx.	Name	Description
12 I 01 I 00208 (201392336)	Maximum mileage value reached	Maximum value for the mileage is reached
12 I 01 I 00209 (201392337)	Mileage warning threshold reached	Threshold value 1 (default: warning threshold) for the mileage is reached
12 I 01 I 00210 (201392338)	Mileage error threshold reached	Threshold value 2 (default: error threshold) for the mileage is reached

Tab. 292 Diagnostic messages

Example

The mileage counter should be reset to 0 and the following threshold values should be parameterized:

– Warning threshold for mileage recording of axis 1: 90000000 user units
– Error threshold for mileage recording of axis 1: 100000000 user units

Parameter settings (example)		
Parameter	Value	Comments
Mileage		
P1.1411.0.0	0	Mileage of axis 1 in user units
Warning threshold for mileage recording		
P1.1417.0.0	90000000	Mileage warning threshold axis 1
Error threshold for mileage recording		
P1.14111.0.0	100000000	Mileage error threshold axis 1

Tab. 293 Parameter settings (example)

9.5.5.2 CiA 402

Mileage counter objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: the user or basic unit defined for the parameter is effective.		
1411	0x2184.01	Mileage 1	LINT
1417	0x2184.05	Mileage warning threshold	LINT
14111	0x2184.08	Mileage error threshold	LINT

Tab. 294 Objects

9.5.5.3 PROFIdrive

Mileage counter PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1411	11339.0	Mileage 1	Integer64
1417	11343.0	Mileage warning threshold	Integer64
14111	11844.0	Mileage error threshold	Integer64

Tab. 295 PNUs

9.5.6 Load change counter

The load change counter records how many reversing backlashes the HEPP completes. The unwanted recording of small positioning differences is suppressed by a hysteresis function (random noise). Two threshold values can be specified per parameterization. A diagnostic message is issued if they are exceeded. The reaction of the HEPP gripper when the threshold value is exceeded can be influenced by specifying the error category.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
1421	Load change counter1	Specifies the current number of load changes for the corresponding axis.	
		Access	read/write

ID Px.	Parameter	Description	
		Update	effective immediately
		Unit	–
1427	Warning threshold load change counter	Specifies the first threshold value when the device should generate the first configured message.	
		Access	read/write
		Update	effective immediately
		Unit	–
14211	Error threshold load change counter	Specifies the second threshold value when the device should generate the second configured message.	
		Access	read/write
		Update	effective immediately
		Unit	–

Tab. 296 Parameter

ID Dx.	Name	Description
12 | 01 | 00211 (201392339)	Maximum load change value reached	The maximum value for the load change is reached
12 | 01 | 00212 (201392340)	Load change warning threshold reached	Threshold value 1 (default: warning threshold) for the load change is reached
12 | 01 | 00213 (201392341)	Load change error threshold reached	Threshold value 2 (default: error threshold) for the load change is reached

Tab. 297 Diagnostic messages

Example

The load change counter should be reset to 0 and the following threshold values should be parameterized:

– Warning threshold for the load change counter of axis 1: 4500000 user units
– Error threshold for the load change counter of axis 1: 90000000 user units

Parameter settings (example)		
Parameter	Value	Comments
Load change		
P1.1421.0.0	0	Rest axis load change to 0
Warning threshold for the load change counter		
P1.1427.0.0	4500000	Load change warning threshold of axis 1
Error threshold for the load change counter		
P1.14211.0.0	90000000	Load change error threshold of axis 1

Tab. 298 Parameter settings (example)

9.5.6.1 CiA402

Load change counter objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: The user or basic unit defined for the parameter is effective.		
1421	0x2185.01	Load change counter 1	LINT
1427	0x2185.05	Warning threshold load change counter	LINT
14211	0x2185.08	Error threshold load change counter	LINT

Tab. 299 Objects

9.5.6.2 PROFIdrive

Load change counter PNUs

Parameter	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1421	11345.0	Load change counter 1	Integer64
1427	11349.0	Warning threshold load change counter	Integer64
14211	11848.0	Error threshold load change counter	Integer64

Tab. 300 PNUs

9.5.7 Operating hour counter

The operating hour counter records how long the 24 V logic supply of the HEPP gripper was switched on.

Parameters and diagnostic messages

ID Px.	Parameter	Description	
1423	Operating hour counter	Specifies the number HEPP operating hours.	
		Access	read/–
		Update	effective immediately
		Unit	s

Tab. 301 Parameter

Example

The operating hours counter should be read.

Parameter settings (example)		
Parameter	Value	Comments
Operating hour counter		
P0.1423.0.0	...	Number of HEPP operating hours

Tab. 302 Parameter settings (example)

Diagnostic messages

No specific diagnostic messages are allocated to the function.

9.5.7.1 CiA402

Operating hour counter objects

Parameter	Index.Subindex	Name	Data type
Px.	Manufacturer-specific objects: the user or basic unit defined for the parameter is effective.		
1423	0x2133.02	Operating hour counter	REAL

Tab. 303 Objects

9.5.7.2 PROFIdrive

Operating hour counter PNUs

Parameters	PNU	Name	Data type
Px.	**Manufacturer-specific parameters**		
1423	2318.0	Operating hour counter	FloatingPoint

Tab. 304 PNUs

10 Maintenance

10.1 Safety

⚠ WARNING

Danger of crushing due to unexpectedly fast-moving loads and unintentional movements.

- Remove the payload
- Switch off power to the product
- Safeguard the power supply from being switched on again unintentionally

10.2 Cleaning

Clean the product with a soft cloth. Do not use aggressive cleaning agents.
For use with reduced particle emission:

– Remove abrasion and contamination from the product on the following schedule:
  – Prior to initial commissioning
  – Regularly during operation

10.3 Lubrication

Interval	Maintenance work
Suggest regreasing after 1 million open and close cycles or after cleaning.	Grease the guide of the gripper jaws & the ball screw. The grease also serves the purpose for rust prevention of the guide and gripper jaws. Permissible lubricating grease: ELKALUB VP 922 (8117071) www.festo.com/spareparts.

The guide should not be touched directly by hands for rust prevention purpose.

- Cut the lubrication interval by half if one of the following applies:
- High thermal stress
- Heavy contamination
- Proximity of grease-dissolving liquids or vapors

Relubricate ball screw and guide

The HEPP gripper should be relubricated after 1 million open and close cycles or after cleaning. Grease should be applied on the guide and the ball screw.
As shown in the figure below, in order to relubricate the ball screw, unscrew the 2 aluminum plug screws by a slotted screwdriver at first. In the next relubricate the ball screw through the 2 threaded holes.
After the ball screw is relubricated, screw back the 2 plug screws to the housing by a tightening torque of 0.8 Nm.

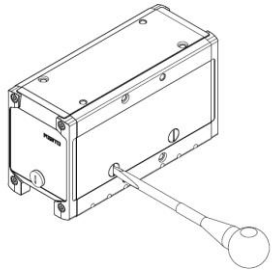


Fig. 59

10.4 Operate full stroke of guide

During the operation the cage of guide could be bended or moved, which may block the motion of the HEPP gripper. This problem can be solved by following steps:

1. Release the brake of the HEPP gripper in the relevant function block;
2. Use a screwdriver to adjust the ball screw manually;
3. Move the cage back to the right position.
4. It is suggested to let the HEPP gripper run freely after long time working, this operation can push the cage back to the right position and keep it in a better operating status.

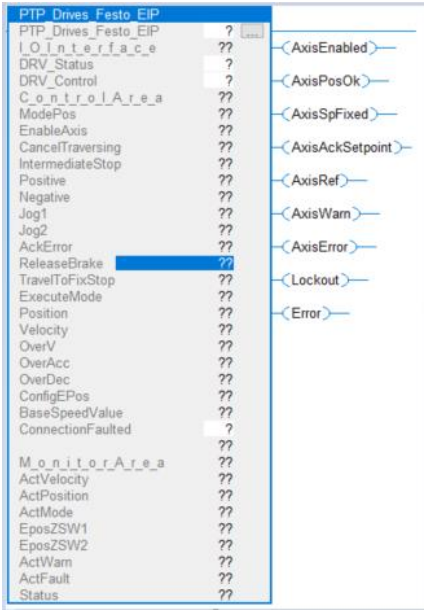


Fig. 60 Figure: EtherNet/IP Function Block

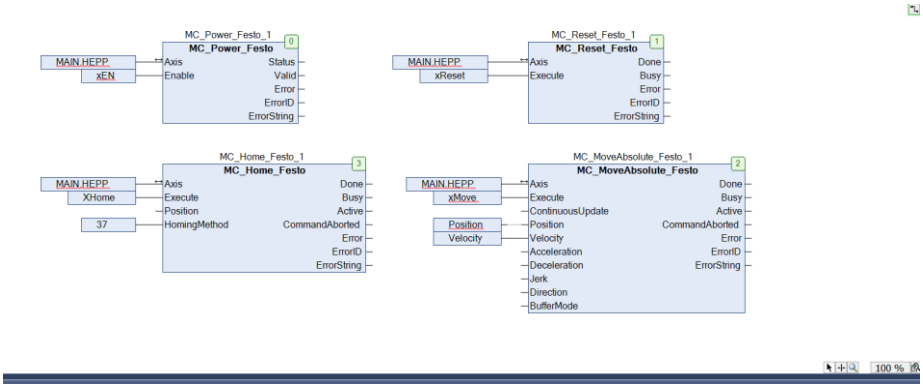


Fig. 61 EtherCAT function block

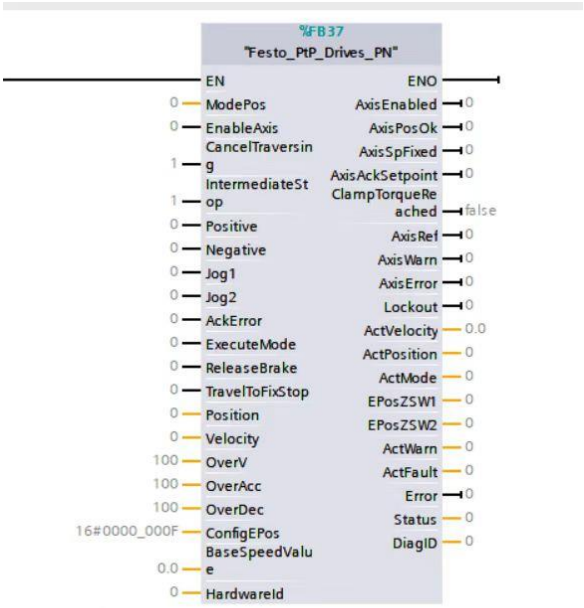


Fig. 62 PROFINET function block

11 Malfunction

11.1 Diagnostics

EtherCAT communication protocol type Interface

Fig. 63

EtherNet/IP communication protocol type Interface

Fig. 64

PROFINET communication protocol type Interface

Fig. 65

LED function description
X: Configuration
-: None

No	Category	Name	Color	EC	EP	PN	description	
1	Device status	Status	g/y/r	X	X	X	Flashed red	An error is present.
							Flashes yellow	A warning is present, or device is currently performing a firmware update.
							Lights up yellow	Device is in the initialization phase.
							Flashes green	Device is ready.
							Lights up green	Device is in the operational status.
2		Power	g/y	X	X	X	Illuminated yellow	The logic power supply is present, but the load power supply is lacking or is currently being measured.
							Illuminated yellow	The load power supply and the logic power supply are present.

No	Category	Name	Color	EC	EP	PN	description	
3	RTE network status	ECAT	g/ r	X	-	-	Off	The device is in the init. status and no error
							Flashed red	Invalid configuration, general configuration error, a status change specified by the master is not possible.
							Flashed red	Local error, the slave device application has independently changed the EtherCAT status. This can have the following causes: A host watchdog time-out has occurred. Synchronization error, the device switches automatically to the safe-operation status.
							Flashes green	The device is in the pre-operational status.
							Flashes green	The device is in the safe-operational status.
							Lights up green	The device is in the operational status.
4		L/A	g/ r	X	-	-	Off	No network connection
							Flickers green (approx. 10Hz)	Data traffic activity (traffic).
							Lights up green	Network connection is OK (link).
5		NF	g/ r	-	-	X	Off	No error
							Flashed red (2 Hz)	Network error – No data transmission – No configuration No network connection or network connection is malfunctioning
6		EIP	g/ r	-	-	-	Off	Logic voltage supply lacking.
							Flashes green	Device is not configured.
							Lights up green	Normal operating status.
							Flashes red/green	Device performs a self-test.

No	Category	Name	Color	EC	EP	PN	description	
							 Flashes red	One or more I/O connections are in the time-out status.
							 Lights up red	The IP address of the device has already been assigned.
7		L/A	g	-	-	-	 Off	No network connection
							 Flickers green	Data traffic activity (traffic)
							 Lights up green	Network connection is OK (link)

Tab. 305

11.2 Fault clearance

WARNING

Danger of crushing due to unexpectedly fast-moving loads and unintentional movements.

- Remove the payload
- Switch off power to the product
- Safeguard the power supply from being switched on again unintentionally

WARNING

Danger of crushing.

The gripper fingers could move unintentionally and crush body parts

- Do not reach into the movement range

Fault description	Cause	Remedy
Gripper does not hold payload firmly.	Gripping points of gripper fingers are too far outwards.	Move gripping points inwards.
	Payload is too heavy.	Select a larger gripper.
Gripper fingers do not move uniformly.	Guides are dirty. Clean and grease the slots.	Clean and grease the guides.
	Gripper jaws are distorted	Rectify the distortion.
Gripper fingers do not move full stroke	Guide cage moved, blocking motion of guide	Operate full stroke of guide, ➔ 10.4 Operate full stroke of guide
Gripper fingers do not open/close.	Jamming due to excessive speed of the gripper fingers	Resolve mechanical jamming of gripper jaws.
	Interruption of communication between gripper and control unit	Check connecting cable. Check fieldbus master
	Gripper is faulty.	Replace gripper.

Fault description	Cause	Remedy
Squeaking noises	Lack of lubrication	Lubricate gripper ➔ 10.3 Lubrication.
	Payload is too great.	Observe permissible values ➔ 13 Technical data

Tab. 306

Resolve mechanical jamming of gripper jaws

Follow the steps below to manually open and close gripper jaws:

- Release the holding brake if the gripper has one, switch off the motor power
- Unscrew the plug screw from the end cap by a suitable slotted screwdriver (slot width 8mm)
- Use a slotted screwdriver to engage the slot on ball screw
  - open gripper jaws by rotating clockwise.
  - close gripper jaws by rotating anti-clockwise.

The plug screw must be fixed on the endcap again by a suitable slotted screwdriver (slot width 8mm) after the manual operations are done. The screw torque should follow 0.6 Nm.

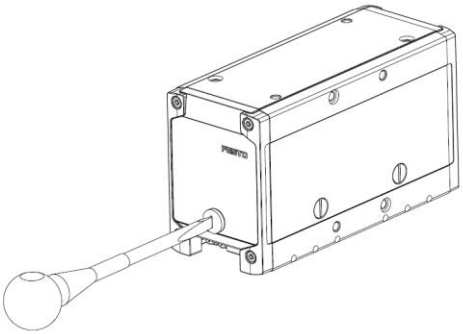


Fig. 66

Unscrew the plug screw from the end cap

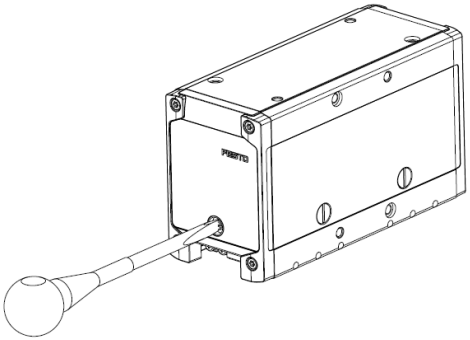


Fig. 67

Rotate the ball screw to open or close gripper jaws

11.3 Repair

Please send the product to the Festo repair service for repair.

12 Disassembly

⚠ WARNING

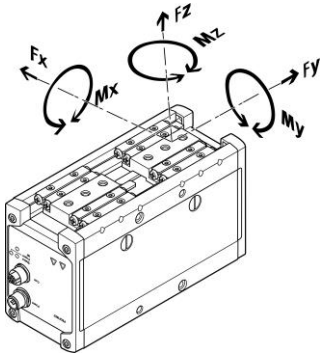
Danger of crushing due to unexpectedly fast-moving loads and unintentional movements.

- Remove the payload
- Switch off power to the product
- Safeguard the power supply from being switched on again unintentionally

13 Technical data

13.1 Technical data, general

HEPP	-28	-36	-42
Constructive design	Electric parallel gripper		
Mounting position	Any		
Mass moment of inertia [kg cm²]	30	54	85
Stroke per jaw [mm]	15	22.5	28
Total stroke [mm]	30	45	56
Gripping force per jaw [N] [1)]	160	260	340
Total gripping force [N] [2)]	320	520	680
Nominal load [kg] [3)]	1	2	3
Nominal torque [Nm]	0.115	0.183	0.185
Positioning speed per jaw [mm/s]	40		50
Positioning acceleration per jaw [mm/s^2]	1		
Gripping speed per jaw [mm/s]	3		
Max. gripper jaw backlash Sz	0.35 mm		
Position detection	Motor encoder		
Rotor position sensor	Absolute encoder, single turn		
Rotor position sensor measuring principle	Magnetic		
Max. permissible length of gripper finger [mm]	Refer to the diagram of the permissible gripping length		
Repetition accuracy [mm]	≤ 0.04	≤ 0.02	≤ 0.02
Nominal load voltage [VDC]	24 ± 10 %		
Nominal logic voltage [VDC]	24 ± 10 %		
Max. load current [A]	2	2	3

HEPP	-28	-36	-42
Max. logic current [A]	1	1	1
Power connection	M12 T coding connector, 4 pins		
Communication connection	M12 A coding connector, 4 pins		
Degree of protection	IP40		
Relative humidity [%]	0 ... 95 (at 25°C non-condensing)		
Ambient temperature [°C]	0 ... +50 (no derating)	0 ... +50 (no derating)	0 ... +40 (no derating) +40 ... +50 (derating see diagram of derating)
Storage temperature [°C]	-25 ... +60		
CE marking (declaration of conformity)	As per EU EMC Directive[4)] To EU RoHS Directive		
UKCA mark (declaration of conformity)	To UK EMC Regs[4)]. To UK RoHS Regs.		
KC mark	KC-EMC[4)]		
Electrical safety	In accordance with standard EN 61010-1:2010		
Weight [Kg]	1.4	2.1	2.6
Material			
Housing	Aluminum		
End cap	Polymer		
Gripper jaws, bearings, guide	Steel		
Max. force (static) and max. torque (static)			
			
Vertical load [N]	680	1100	1100
Transverse load [N]	680	1100	1100
Mx [Nm]	6.5	13.9	13.9
My [Nm]	14.5	34.5	38.5
Mz [Nm]	6.5	13.9	13.9

1) Total gripping force = 2 ×Gripping force per jaw
2) Gripping force tolerance: ±15% F.S. for HEPP-42, ±20% F.S. for HEPP-36, ±25% F.S. for HEPP-28
3) Nominal load = gripper fingers + payload, the service life of the electric gripper will be reduced if the payload weight is higher than the value.
4) Only when using the connecting cable from Festo

13.2 Maximum permitted finger projection

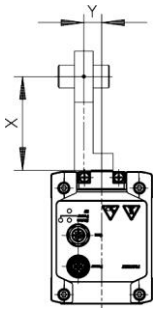


Fig. 68

Gripping point x = Vertical distance outside the center of the gripping jaws
Gripping point y = horizontal distance outside the center of the gripping jaws

- If the position of the gripping point is outside the limit value, this can shorten the service life of the electric gripper.
- Use the gripping point as short as possible to increase the service life.
- The values in the diagram apply at a speed <= 3 mm/s per gripper jaw.

Gripping force must be limited in permitted area, depends on the gripping point:

HEPP-42

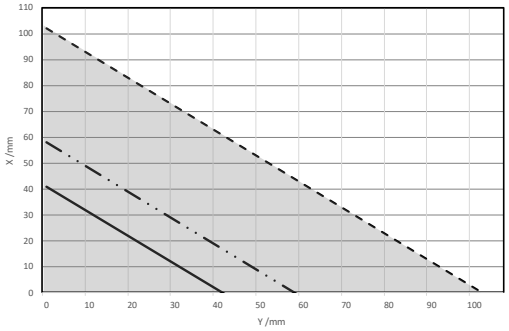


Fig. 69

F for 100% Permitted range
F for 70%
F for 40%

HEPP-36

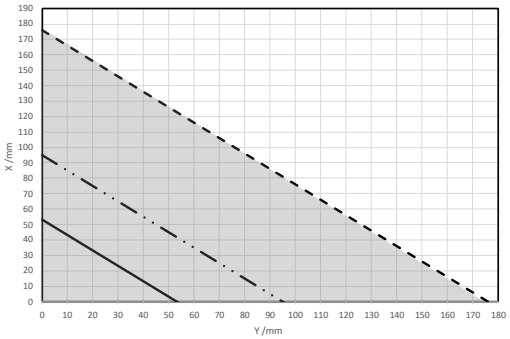


Fig. 70

F for 100% Permitted range
F for 70%
F for 40%

HEPP-28

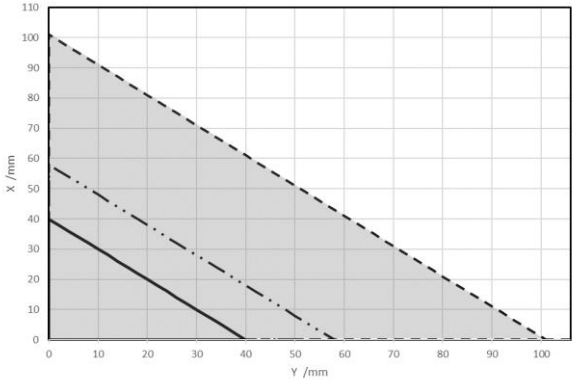


Fig. 71

F for 100% Permitted range
F for 70%
F for 40%

13.3 Gripping Force F as a function of Lever Arm x

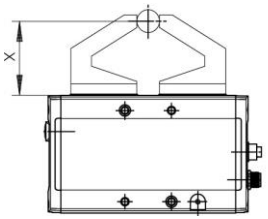


Fig. 72

Lever arm x = distance from gripper jaw surface to gripper center point

HEPP-42
With longer gripping fingers, a larger force reserve is recommended due to the longer lever arm.
Total gripping force F as a function of lever arm x for HEPP-42.

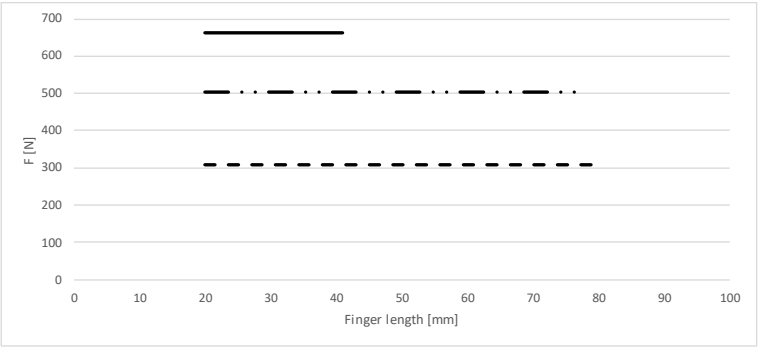


Fig. 73

F for 100%
F for 70%
F for 40%

HEPP-36
With longer gripping fingers, a larger force reserve is recommended due to the longer lever arm.
Total gripping force F as a function of lever arm x for HEPP-36.

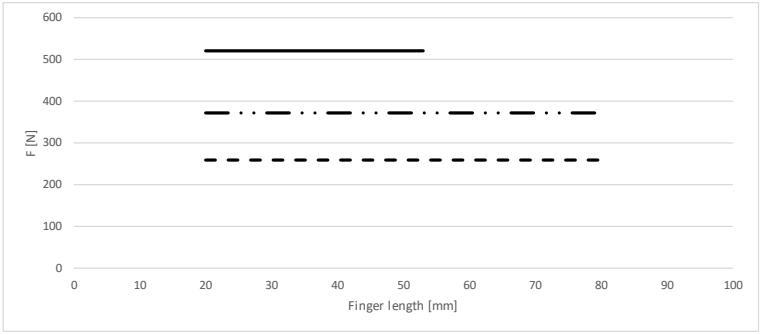


Fig. 74

F for 100%
F for 70%
F for 40%

HEPP-28
With longer gripping fingers, a larger force reserve is recommended due to the longer lever arm.
Total gripping force F as a function of lever arm x for HEPP-28.

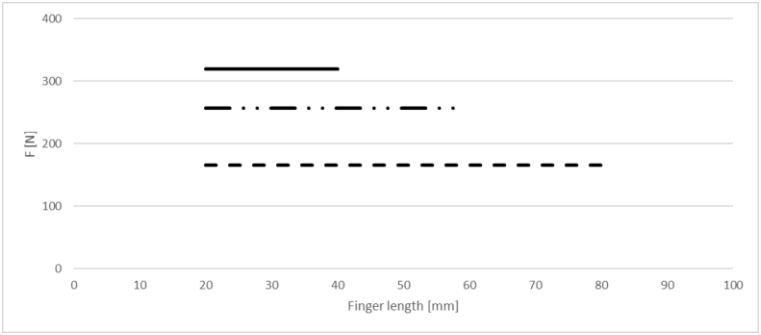


Fig. 75

F for 100%
F for 70%
F for 40%

13.4 Derating

Motor current I as a function of ambient temperature t

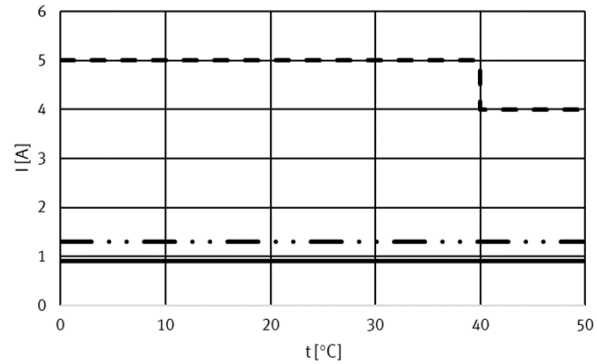


Fig. 76

HEPP-28
HEPP-36
HEPP-42

13.5 Gripping force F vs. motor current I

The values in the diagram apply at a speed <= 3 mm/s per gripper jaw.
At a motor current below 25%, the repeatability of the force is reduced.

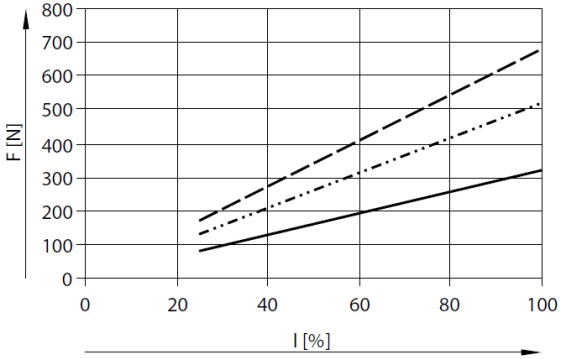


Fig. 77

HEPP-28
HEPP-36
HEPP-42

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